付 属 資 料　2

団 長 レ タ ー （英 語）

調 査 団 礼 状 （英 語）

団 長 レ タ ー

December 13, 1994

Mr. Arun Ramanathan
Member Secretary,
Central Silk Board,
Ministry of Textiles, India

Dear Sir,

It is my great pleasure to submit herewith the summary report of the JICA Technical Guidance Team (hereinafter referred to as "the Team") on the Bivoltine Sericulture Technology Development Project in India (hereinafter referred to as "the Project") as shown in the attached.

The Team, organized by Japan International Cooperation Agency (hereinafter referred to as "JICA"), visited India for 13 days from December 4th to 16th, 1994 for the purpose of investigation and recognition of the present situation of the Project.

I would like to take this opportunity to express my sincere appreciation for all the kind arrangements you made for us as well as the warm cooperation extended to all the members of the Team. Owing to your kind cooperation, we could accomplish the purpose of our visit here.

Very truly yours,

河上清

Kiyoshi Kawakami
Team Leader
JICA Technical Guidance Team

CONTENTS OF SUMMARY REPORT

Summary Report

I. Result of Investigation

1. Summary of Investigation

The Project, in accordance with R/D and TIP, signed in 16, April, 1991 has been managed successfully by the inputs of both Japanese and Indian governments. Both Japanese experts and Indian counterparts have made strenuous efforts in achieving the objectives of the Project. As results of the Teams's investigations, it was recognized that activities of the Project coverd many fields and many progresses had been done. The followings are remarkable progresses in each section.

1) Silkworm breeding technology: Seven bivoltine excellent lines have been selected.
2) Silkworm disease control technology: Main silkworm diseases were identified. Disease control techniques for Pebrine was successfully developed in cooperation with Silkworm seed production section.
3) Silkworm rearing technology: The standard rearing manuals for young and late age silkworm were prepared and they are being tested.
4) Mulberry breeding and cultivation technology: Excellent mulberry lines were selected and multiplication method has been developed.
5) Silkworm seed production technology: Loose egg preparetion technology and mother moth testing method for Pebrine have been established. The standard manuals for those techniques have been prepared.
6) Reeling technology: The cocoon quality evaluation method has been established and this method is used for practical test. Further, the denir indicator divice suitable to Indian environment is developed.

2. Input to the Project

(1) Japanese Contributions

1) Dispatch of Japanese experts

Based on R/D and TIP, long-term and short-term experts have been dispatched. There are six(6) long-term experts and two(2) short-term experts now in the Project. The details are shown in Annex 3.

A long-term expert in the field of Silkworm Breeding went back to Japan due to injury. The Leader has temporarily taken her duties over and makes best efforts so as not to hinder the progress of the activities.

2)Training of Indian counterparts in Japan

Based on R/D and TIP, JICA has duly accepted about five(5) counterparts per year. The details are shown in Annex 4.

All counterparts trained in Japan are diligently doing their best to apply their studies to the development of Indian bivoltine sericulture.

3)Provision of machinery and equipment

Equipment provided by JICA are shown in Annex 5. They generally meet the need of the Project, and most of them are well maintained and put into use appropriately.

4)Local Cost Affairs of JICA

The details of local cost by JICA are shown in Annex 6.

(2)Indian Contributions

1)Allocation of counterparts

There were forty-two(42) counterparts allocated to this Project at the beginning(twenty(20) full-time counterparts, twenty-two(22) part-time counterparts). Now, the total number of counterparts has increased to forty-eight(48) (thirty-one(31) full-time counterparts, seventeen(17) part-time counterparts) with more full-timers. The present allocation of counterparts is shown in Annex 7.

2)Operating Costs

The Government of India has released satisfactory operation and management cost necessary for the Project. The details are shown in Annex 8(together with provision of land, buildings and facilities).

3)Provision of land, buildings and facilities

Administrative building of Silkworm Seed Technology Laboratory (SSTL) has not been constructed yet, so some laboratory space is still occupied for administration purpose. This makes it difficult to the smooth implementation of the Project. Since the Project is coming to the end, the Team strongly hope that the administration building mentioned above will be constructed as soon as possible. Other buildings, facilities and lands are satisfactorily provided for the smooth implementation of the Project.

3.Project activities

Mid-term evaluation team visited India last year, evaluated each activities of the Project according to accomplishment levels, which are A(more than 75%), B(50% ～75%), C(25% ～50%), D(less than 25%) and E(elimination from the activities of the Project should be better).

Fortunately, there was no E. The Team investigated the present situation of the Project based on these scores and recognized that the Project was in smooth progress. The details of the activities and accomplishment of the Project are shown in Annex 9. Summaries of progress and activities for the remaining period for each section are as follows.

(1) Development of Silkworm Breeding Technology

[Progress]

The improvement is being carried out on the Indian existing silkworm races. Out of the 163 existing races, seven new hybrid lines have been selected. The pupation rate of seven selected lines are more than 90% and their cocoon shell percentages are between 20% - 25%. These lines mostly have similar degree of qualities as Japanese hybrids in all respects. Certain experiments are under progress for evolving high temperature resisitance races. The maintenance guidelines for the selected lines have been prepared. Through the transfer of technology in these experiments, it is very much evaluated that the counterparts who did not take so much interests in quality and quantity of cocoon are now keen to establish varieties which have good quality and quantity.

[Activities for the remaining period]

Every type of regional and seasonal adaptability test will be conducted. Based on this, the hybrid evaluation methods will be developed. Similarly, development of improved silkworm races for robustness, high silk contents and high silk quality will be promoted. Further, the maintanance and preservation techniques to keep the characteistics of newly evolved races intact will be established.

(2) Silkworm Disease Control Technology

[Progress]

Under this section, at the begining, to develop the disease control technology for Pebrine disease was most important. And the mother moth testing method has been standardised. Based on this method, the occurence of Pebrine disease has decreased to almost 0% from 30% - 40% which was existing previously by examing the limited number of samples. Secondly, the study on the main viral diseases started last year, and diagnosis and identification of main viral disease in existance were done mainly. So that, it proved that the occurence of grasserie disease was the most big problem. Further, the IFV and DNV diseases were also identified, which was not done till then. On the other hand, the CPV, which is detected in Japan, seems to be not existing in India. Further,

it was clearly understood that the cowdung application to rearing tray is a infectious sourse for grasserie and difficult to disinfect.

[Activities for the remaining period]

In regard to the disinfection method against viral disease and microspridian disease, the suitable method is being studied in accordance with Indian conditions. As for microsporidian diseases, the present experiments will be continued and the transovum transmission of NIK-3h and NIK-4m will be studied. A standard manuals of disinfection method and disease control method for prevention of viral disease and Pebrine disease will be prepared for farmers and extension officers.

(3) Development of Silkworm Rearing chnology

[Progress]

The mulberry variety selection experiment has been done for the use of young age silkworm rearing and there was difference among the varieties. Based on the shoot feeding, the four times leaf feeding per day was able to reduce to two or three feedings per day. Further, a new mounting apparatus is evolved, and experiments on spinning of cocoon on this newly evolved apparatus are under progress. In order to prepare a standard manual for young and late age silkworms rearing, a standard table has been prepared and it is under field trial. Moreover, within the remaining period a stnadard manual completion is anticipated.

[Activities for the remaining period]

Standard manual about techniques of breeding young and late age silkworm, mounting, and harvesting cocoon will be prepared.

(4) Development of Mulberry Breeding and Cultivation Technology

[Progress]

From the existing Mulberry lines and hybrid conbinations, expected excellent varieties have been selected. The multiplication method of new saplings has been developed by which whole shoot could be used for preparation of sapling. Further, based on the different spacing and repeated pruning, hereafter development of shoot harvesting technology for higher yield than before is anticipated.

[Activities for the remaining period]

A standard manual regarding mulbery cultivation technology including plantations, fertilizer applications, irrigations, ploughing

and pest control will be prepared.

(5) Development of Silkworm Seed Production Technology

[Progress]

It has become possible to identify the different stages during embryo development. The silkworm egg preservations technique has been established. The suitable mulberry variety for late age silkworm of seed cocoon has been identified. The loose egg productions technology is established and a standard manual has been prepared. Based on the mother moth testing technique established by Pathology section, examination is put into practice, and a standard manual is prepared already. Morever, trainings based on this manual have been carried out and succeeded much. Further, in case of the 3-way cross hybrid, the results obtained on regional and seasonal suitability test are compiled, and suitable races for regional and seasonal condition have been selected.

note: Though the 3-way cross hybrid test was not in the original TIP, the proposal was made by the Japanese side at the Second Joint Committee and this activity has got a considerable result, so it is descided that this is specially mentioned here.

[Activities for the remaining period]

Utilizing the standard manual, the silkworm seed producers training should be continuously conducted. Further, with co-operation of rearing and moriculture sections, silkworm rearing technology for silkworm seed producing should be established.

(6) Development of Silk Reeling Technology

[Progress]

It was observed that the necessary techniques for cocoon drying, cocoon cooking methods, and so on have been developed for preparation of standard manual. The cocoon testing method is also developed, and a test manual has been prepared and used for testing cocoons including the new races, and is used at the laboratory level. Further, a denir indicator has also been developed.

[Activities for the remaining period]

The reeling and rereeling technology should be established, experiment should be conducted on integrated way to prepare a standard manual. A standard manual will be prepared on raw silk testing suitable to bivoltine cocoons.

Ⅱ. Recommendation

In consideration of progress mentioned above and the time limit of remaining period of the Project, it is higly recommendable that special consideration should be given to the following items on the whole.

(1) The practical bivoltine sericulture technologies suitable to the Indian circumstance should be developed.

(2) It is very important that each section should further cooperate each other, and that important subjects should be selected, in order to develop practical technologies mentioned in (1).

(3) The Indian side should take specific steps to utilize the developed technologies most effectively.

ANNEXES

Annex 1 The Members of the Team

(1) Mr. Kiyoshi Kawakami: Leader
Former Director General,
National Institute of Sericultural and Entomological Science, MAFF

(2) Mr. Kunio Takamiya: Silkworm Technology,
Entomological Research Coordinator,
National Institute of Sericultural and Entomological Science, MAFF

(3) Mr. Kotaro Iwashita: Mulberry Technology
Deputy Director, Sericulture Division,
Agricultural Production Bureau, MAFF

(4) Mr. Seiichi Kunimatsu: Sericultural Development
Deputy Director, Sericulture Division,
Agricultural Production Bureau, MAFF

(5) Ms. Ako Muto: Coordination
Staff, Livestock Technical Cooperation Division,
Agricultural Development Cooperation Department, JICA

Remarks MAFF: Ministry of Agriculture, Forestry and Fisheries
JICA: Japan International Cooperation Agency

Annex 2 Schedule of the Team

December 4 (Sun) Arrival in New Delhi

5 (Mon) Discussion with the JICA office staff
Courtesy call to the Embassy of Japan
Courtesy call to the Ministry of Textiles
Courtesy call to the Ministry of Finance, Department of Economic Affairs

6 (Tue) Move to Bangalore
Courtesy call and discussion to the Central Silk Board
Visit and investigation of the Central Silk Technological Research Institute
Visit and investigation of the National Silkworm Seed Project
Visit and investigation of the Seed Production Center
Visit and investigation of the Silkworm Technology Laboratory

7 (Wed) Visit and investigation of the Seed Production Center
Visit and investigation of the Cocoon Market
Visit and investigation of the Reeling Company
Move to Mysore

8 (Thu) Visit and investigation of the Central Sericultural Research and Training Institute
Visit and investigation of the sericulture farmers in the area of K.R.Pet

9 (Fri) Discussions with Japanese experts and Indian counterparts

10 (Sat) Discussions with Japanese experts and Indian counterparts

11 (Sun) Public holiday

12 (Mon) Preparing summary report

13 (Tue) Move to Bangalore
Final discussions
Submission of a summary report
Move to New Delhi

14 (Wed) Visit and investigation of the sericulture farmars near New Delhi

15 (Thu) Report to JICA office
Report to Embassy of Japan

16 (Fri) Move to Japan

Annex 3 Dispatch of Japanese Experts

DISPATCH OF EXPERTS (LONG TERM))

FISCAL YEAR	NAME (FIELD) YEAR	1991	1992	1993	1994	1995	1996
(12)	DR. KIYOSHI KITAURA (TEAM READER, MULBERRY BREEDING AND CULTIVATION)	7/18		4/14			
	MR. YASUHISA MANO (SILKWORM BREEDING)	7/18			7/17		
	MR. JIRO OBITSU (COORDINATOR)	7/18				7/17	
	DR. TAMIO INOGUCHI (SILKWORM REARING)	9/ 5		9/ 4			
	DR. TADASHI FUJIWARA (SILKWORM DISEASE)	10/17		10/16			
	MR. KENNICHI TAJIMA (SILKWORM SEED PRODUCTION)	10/17		10/16			
	DR. YOSHIKI OHTSUKI (TEAM LEADER)			5/27		5/26	
	MR. KIYOTO HASEGAWA (MULBERRY BREEDING AND CULTIVATION)			7/29		7/28	
	DR. SUSUMU UTSUMI (SILKWORM DISEASE)			10/28		10/27	
	MR. TOSHIO HASHIGUCHI (SILKWORM SEED PRODUCTION)			10/28		10/27	
	MR. AKIYOSHI MUROGA (SILKWORM REARING)				5/26		5/25
	MS. HIROKO MATSUO (SILKWORM BREEDING)				7/ 7		7/ 6

DISPATCH OF EXPERTS (SHORT TERM))

FISCAL YEAR	NAME (FIELD) YEAR	1992	1993	1994	1995
1991 (2)	MR. SHOUEI ISHI (SILK REELING)	1/30 — 3/ 8			
	DR. CHIYUKI TAKABAYASHI (SILK REELING)	1/30 — 3/22			
1992 (6)	DR. TAKERU SATOU (SILKWORM DISEASE CONTROL)	7/17 — 8/ 9			
	MR. HARUHIKO FUJITA (MULBERRY BREEDING AND CULTIVATION)	9/ 6 — 10/15			
	MR. HARUO KINOSHITA (SILK REELING)	9/ 6 — 12/ 3			
	DR. HIROMI TAKIZAWA (SILKWORM SEED PRODUCTION)		1/27 — 3/14		
	MR. YUJI MATSUURA (SILKWORK REARING)		1/27 — 3/26		
	DR. TOSHIO YAMAMOTO (SILKWORM BREEDING)		3/10 — 5/ 1		
1993 (5)	DR. OSAMU NINAGI (SILKWORM BREEDING)		10/14 — 12/26		
	DR. KOUZOU TSUBOUCHI (SILK REELING)		10/14 — 12/26		
	MR. DAIYU ITOU (MULBERRY CULTIVATION)		12/ 2 — 2/28		
	MR. MASAO KATOU (SILKWORM REARING)				
	MR. AKIO KOYAMA (MULBERRY BREEDING AND CULTIVATION)				
1994 (3)	MR. HISASHI TSUBOI (SILK REELING)			11/ 6 — 3/ 5	
	MR. MAKOTO SUZUKI (MULBERRY BREEDING AND CULTIVATION)			11/ 6 — 12/18	
	MR. HITOSHI WATANABE (SILKWORM DISEASE CONTROL)			12/15 — 3/ 1	

Annex 4 Acceptance of Indian Counterpart Trainees in Japan

Fiscal Year	NAME (FIELD) YEAR	1991	1992	1993	1994
1990 (1)	DR. S. N. CHATTERJEE (SILKWORM BREEDING)	29/5 ——1/12			
1991 (5)	SHRI. CHANDRASHEKHARAIAH (SILKWORM SEED PRODUCTION)	29/5 ——1/12			
	MR. MURTUZA BAIG (SILKWORM DISEASE CONTROL)	26/11 ———	28/10		
	DR. VINOD B. MATHUR (SILKWORM REARING)	26/11 ———	28/10		
	DR. PUTTASWAMY GOWDA (SILKWORM SEED PRODUCTION)	26/11 ———	28/10		
	SMT. VIJAYALAKSHMI RAO (SILK REELING)	26/11 ———	28/10		
1992 (5)	SHR. H. K. BASAVARAJA (SILKWORM BREEDING)		15/ 6 ———	3/ 3	
	SRI. BHANUPRAKASH RAJ (SILK REELING)		15/ 6 ———	3/ 3	
	MR. B. NATARAJU (SILKWORM DISEASE CONTROL)		23/11———	31/ 8	
	SRI. B. S. ANGADI (SILKWORM SEED PRODUCTION)		23/11———	31/ 8	
	DR. A. SARKAR (MULBERRY BREEDING AND CULTIVATION)		23/11———	29/ 9	
1993 (5)	MR. NIRMAL KUMAR (SILKWORM BREEDING)			12/ 7 ———	5/ 4
	SHRI. G. HARIRAJ (SILK REELING)			12/ 7 ———	7/ 6
	DR. K. K. RAJAN (SILKWORM REARING)			25/10———	4/10
	DR. RAMAKANT (MULBERRY BREEDING AND CULTIVATION)			25/10———	24/10
	DR. G. VEMANADA REDDY (SILKWORM SEED PRODUCTION)				7/2 —— 20/12
1994 (4)	MR. GANGESH BAHADUR SINGH (SILKWORM REARING LATE AGE AND MOUNTING TECHNOLOGY METHODS)				4/18——— 12/16
	MR. NIMMANAPALLI MALREDDY (BREEDING OF BIVOLTINE SILKWORM RACE)				4/18——— 12/16
	MR. ASWANTH REDDY (REELING TECHNOLOGY)				4/18——— 11/15
	MR. THEEYANCHERI OTHAYOTH SASIDHARAN (PEBRIN CONTROL FOR SEED PRODUCTION)				8/29———3/ 5

Utilization of Equipment& Machinery Provided by JICA in 91/92
Costing More Than ¥16 Lakhs
(BSTD Project)

31/8/92

No.	Name of Equipment Including Its Model, Capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utilization	Section Kept	Unit Price in ¥1,000	Number in Sticker	Remarks
3-04	自動繭個体秤量機 ザルトリウス Automatic Cocoon Weighting System	1	0	1	A	B1	2, 220	3-3-04-B-1	
7	トヨタ ランドクルーザー トヨタ Toyota Land Cruiser	3	0	3	A	CSR&TI 2,S 1	2, 210	3-7-C-1 3-7-C-2 3-7-S-1	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing Section, P:Pathology Section, S:Silkworm Seed Technology Laboratory, C:CSR&TI

Utilization of Equipment& Machinery Provided by JICA in 91/92
Costing More Than ¥1 Lakh and Less Than ¥16 Lakhs
(BSTD Project)

31/8/92

NO.	Name of Equipment Including Its Model , Capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utilization	Section Kept	Unit Price In ¥1,000	Number In Sticker	Remarks
1-02	桑刈機 共栄社 MR40型 Mulberry Leaf Heckler	1	0	1	A	M	634	3.1-02-M-1	
2	動力ざ桑機 側島 KC4型平和号 Motor Power Leaf Chopper Model KC-4(220V.)	2	0	2	A	B1, R1	570	3.2-B-1 3.2-R-1	
3-01	電子式記録台秤 ザルトリウス LC34000P型 Electronic Counter Scales Sartorius Model LC 34000P (220V) with adapter ,printer etc.	2	0	2	A	B1, R1	557	3.3-01-B-1 3.3-01-R-1	
4-01	電子式自記温湿度計 日本計量器 NWR-9003E型 Electronic Thermo-Hydrograph ,Nihonkeiryouki Model NWR-9003E	8	0	8	A	B2, R2, P2, S2	105	3.4-01-B-1 3.4-01-B-2 3.4-01-R-1 3.4-01-R-2 3.4-01-P-1 3.4-01-P-2 3.4-01-S-1 3.4-01-S-2	
4-03	動力噴霧器 側島 ,KEH-15型 Motor Power Sprayer Model KEH-15	3	0	3	A	R1 , B1, S1	256	3.4-03-R-1 3.4-03-B-1 3.4-03-S-1	
4-07	収繭毛羽取機 側島 MK-1型 Cocoon Harvester Floss Remover Model MK-1	1	0	1	A	R	235	3.4-07-R-1	
9	ホモジナイザー 日本精機 AM-11型 Homogenizer Nihon Seiki Model AM-11	2	0	2	A	P1, S1	432	3.9-P-1 3.9-S-1	
6	ｲﾝｷｭﾍﾞｰﾀｰ ｻﾝﾖｰ MIR-552 型 Incubator Sanyo model MIR-552	4	0	4	A	B3, R1	750	3.6-B-1 3.6-B-2 3.6-B-3 3.6-R-1	
8	熱風乾燥機 ﾔﾏﾄ科学 DF-62 型 Dry Oven ,Yamato Kagaku Model DF-62	3	0	3	A	M1, B1, P1	600	3.8-M-1 3.8-B-1 3.8-P-1	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing Section, P:Pathology Section, S:Silkworm Seed Technology Laboratory, C:CSR&TI,

Utilization of Equipment& Machinery Provided by JICA in 91/92
As Unaccompanied Baggages
Costing More Than ¥1 Lakh and Less Than ¥16 Lakhs
(BSTD Project)

31/8/92

No.	Name of Equipment Including Its Model, Capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utilization	Place Kept	Unit Price in ¥ 1,000	Number in Steker	Remarks
K-01	ワードプロセッサー, Word Processor CANOWARD ALPHA 65W	1	0	1	A	C1(Coordinator's Room)	164	3-K-01-C-1	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing Section, P:Pathology Section, S:Silkworm Seed Technology Laboratory, C:CSR&TI

Utilization of Equipment & Machinery Provided by JICA in 92/93
Costing More Than ¥16 Lakhs
(BSTD Project)

31/8/93

No.	Name of Equipment Including Its Model, capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utililation	Place Kept	Unit Price in ¥ 1,000	Number in Sticker	Remarks
29	自動繭個体秤量機 ザルトリュウス, Automatic Cocoon Weighing System	1	0	1	A	B1	2, 244	4-29-B-1	
15	母蛾磨砕機 稲口機械 Silkworm Moth Smashing Machine Model:HM-20	1	0	1	A	B1	5, 787	4-15-B-1	
11	糸質検査装置 新増沢工業 Thread Eveness and Cleaness Inspecting Apparatus ,SMM-001	1	0	1	A	B1	11, 070	4-11-B-1	
07	一粒繰り糸機 新増沢工業 Mono Cocoon Reering Machine	1	0	1	A	B1	2, 200	4-07-B-1	
04	携帯用光合成測定装置 LIcor 社 Portable Photosinthecis System(LI-6200)	1	0	1	A	M1	6, 300	4-04-M-1	
05	蚕飼育用恒温恒湿装置 中央製作所 Temperature & Humidity Control Equipments for Silkworm Rearing (SERICATRON)	8	0	8	A	B3, R3, S2	4, 422	4-05-B-1 4-05-B-2 4-05-B-3 4-05-R-1 4-05-R-2 4-05-R-3 4-05-S-1 4-05-S-2	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing Section, P:Pathology Section, S:Silkworm Seed Technology Laboratory, C:CSR&TI

Utilization of Equipment & Machinery Provided by JICA in 92/93
Costing More Than ¥10 Lakhs and Less Than ¥16 Lakhs
(BSTD Project)

31/8/93

No.	Name of Equipment Including Its Model , Capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utilization	Place Kept	Unit Price in ¥ 1,000	Number in Sticker	Remarks
05-1	軟水器 、 中央製作所 、HS－20 Water Softener,HS-20	3	0	3	A	B1, R1, S1	200	4-05-1-B-1 4-05-1-R-1 4-05-1-S-1	
06	台車式条桑飼育装置 、 側島、 1段式 Single Joso Rearing Device	4	0	4	A	R4	399	4-06-R-1 4-06-R-2 4-06-R-3 4-06-R-4	
10	冷却遠心分離機 、トミー、RL－101 Refrigerated Centrifuge Main body(RL-101)	1	0	1	A	P1	858	4-10-P-1	
12	倒立顕微鏡 ニコン TMS-F13 Inverted Microscope (TMS-F13)	1	0	1	A	P1	782	4-12-P-1	
16	ﾊﾝﾏｰﾅｲﾌﾓｱｰ 佐藤農機 HM-20 Hammer knife Mowing Machine(HM20)	1	0	1	A	M1	565	4-16-M-1	
17-1	ｲﾝｷｭﾍﾞｰﾀｰ Sanyo Incubator MIR-552	6	0	6	A	P4, M1, S1	781	4-17-1-P-1 4-17-1-P-2 4-17-1-P-3 4-17-1-P-4 4-17-1-M-1 4-17-1-S-1	
17-2	ｲﾝｷｭﾍﾞｰﾀｰ Sanyo Incubator MIR-252	4	0	4	A	R2, S2,	508	4-17-2-R-1 4-17-2-R-2 4-17-2-S-1 4-17-2-S-2	
17-3	ｲﾝｷｭﾍﾞｰﾀｰ Sanyo Incubator MIR-152	4	0	4	A	S4	362	4-17-3-S-1 4-17-3-S-2 4-17-3-S-3 4-17-3-S-4	
18	熱風乾燥機 ヤマト科学 DF-62 ,Dry Oven ,Yamato Kagaku Model DF-62	1	0	1	A	B1	657	4-18-B-1	
23	ｸﾘｰﾝﾍﾞﾝﾁ ﾀｶﾄﾝ Clean Bench (PAF-1300BN)	1	0	1	A	S1	1,110	4-23-S-1	
24	加湿器 ピーエス 工業 200M2 Humidifier	8	0	8	A	B4, R2, P2	152	4-24-B-1 4-24-B-2 4-24-B-3 4-24-B-4	

								4-24-R-1 4-24-R-2 4-24-P-1 4-24-P-2	
9	耕耘機 久保田 TI-55SKB ,Mini Tractor Kubota ,TI-55SKB	1	0	1	A	M1	467	4-09-M-1	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing Section, P:Pathology Section , S:Silkworm Seed Technology Laboratory, C: CSR&TI

(2)

Utilization of Equipment & Machinery Provided by JICA in 92/93
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Costing More Than ¥1 Lakh and Less Than ¥16 Lakhs
(BSTD Project)

31/8/93

No.	Name of Equipment Including Its Model , Capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utilizaytion	Place Kept	Unit Price in ¥ 1,000	Number in Sticker	Remarks
K-01	ワードプロセッサー Word Processor PWP-5S1G NEC	1	0	1	A	C 1(Leader's Room)	116	4-K-01-C-1	
K-02	ワードプロセッサー Word Processor CANOWARD ALPHA65W	1	0	1	A	C 1(Coordinator's Room)	140	4-K-02-C-1	
K-10	ビデオカメラ Video Camera CCD-TRI	1	0	1	A	S 1	161	4-K-10-S-1	
K-11	ワードプロセッサー文豪 Word Processor Bungo Mini NEC	1	0	1	A	S 1	122	4-K-11-S-1	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing Section, P:Pathology Section, S:Silkworm Seed Technology Laboratory, C:CSR&TI

Utilization of Equipment & Machinery Provided by JICA in 93/94
Costing More Than ¥16 Lakhs
(BSTD Project)

31/8/94

No.	Name of Equipment Including Its Model, Capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utilization	Place Kept	Unit Price in ¥ 1,000	Number in Sticker	Remarks
1	集団母蛾検査装置 ,Separator of Pebrin from Mass of Moth ,Main Unit ,Model SPM-2	1	0	1	A	S 1	6,110	5-1-S-1	
2	浸透圧計 ,Osmotic Pressure Meter , Model Om-801	1	0	1	A	M 1	1,810	5-2-M-1	
3	ワールブルグ検圧計 ,Warburg's Manometric Apparatus Model ;WB-R with Transformer	1	0	1	A	S 1	2,870	5-3-S-1	
4	超音波洗浄器 , Ultrasonic Cleaner , Model : CA-7359	1	0	1	A	S 1	1,675	5-4-S-1	
5	繭切開期 , Breeding Cocoon Cutting Machine	1	0	1	A	S 1	2,790	5-5-S-1	
6	小枠浸透槽 , Small Reel Permeation Device	1	0	1	A	T 1	4,242	5-6-T-1	
7	葉面積計 , Leaf Area Meter , Model : BLS-COMP	1	0	1	A	M 1	3,130	5-7-M-1	
8	繭検査用自動操糸機 , Automatic Silk Reeling Machine ,Compact Type ,for Cocoon Testing Model CT-52	1	0	1	A	T 1	34,500	5-8-T-1	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing section, P:Pathology Section, S:Silkworm Seed Technology Laboratory, T:CSTRI

Utilization of Equipment & Machinery Provided by JICA in 93/94
Costing More Than ¥10 Lakhs and Less Than ¥16 Lakhs
(BSTD Project)

31/8/94

No.	Name of Equipment Including Its Model, Capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utilization	Place Kept	Unit Price in ¥1,000	Number in Sticker	Remarks
1-01 -02 -03	トヨクランドクルーザー 用エアコン , Air Conditioner for Toyota Land Cruiser	3	0	3	A	C 2 , S 1	323	5-1-01-C-1 5-1-02-C-2 5-1-03-S-1	
2	炭酸 ガス インキュベーター , CO2 Incubator MCO-175	1	0	1	A	P 1	1,040	5-2-P-1	
3	回転ミクロトーム , Rotary Microtome ,Model PR-50	1	0	1	A	S 1	590	5-3-S-1	
4	マルチ ガス インキュベーター , Multi-Gas Incubator MCO-175M	1	0	1	A	S 1	1,470	5-4-S-1	
5-01 -02	マルチ チャンネル ピペット , Multi-Channel Pipet Model 8800	2	0	2	A	M 2	107	5-5-01-M-1 5-5-02-M-2	
6-01 -02 -03	電子式温湿度記録計, Electronic Thermo-Hygrograph ,Model 3-C	3	0	3	A	B 1 ,R 2	753	5-6-01-B-1 5-6-02-R-1 5-6-03-R-2	
7-01 -02	分光光度計 ,Spectrophotometer , Model U-1100	2	0	2	A	R 1 ,M 1	730	5-7-01-R-1 5-7-02-M-1	
8	分光光度計付属品 ,サンプル シパー ,Sample Sipper , Accessary for Spectrophotometer	2	0	2	A	R 1 ,M 1	142	5-8-R-1 5-8-M-1	
9	実体顕微鏡 ,Stereo Microscope , SMZ-1-3	1	0	1	A	M 1	218	5-9-M-1	
10	自記雨量計 , Rain Gauge ,	1	0	1	A	M 1	176	5-10-M-1	
11	電気泳動装置 , Slab Electro Phoresis	1	0	1	A	M 1	92	5-11-M-1	
12	電気泳動装置用乾燥機, Slab Gel Dryer,EG-220	1	0	1	A	M 1	161	5-12-M-1	
13	電気泳動装置用動力装置 ,Power Unit ,PS-520	1	0	1	A	M 1	118	5-13-M-1	
14	電気泳動装置用手動ポンプ ,Handy Pump ,VP-15	1	0	1	A	M 1	202	5-14-M-1	
15	オートクレーブ ,Autoclave ,Model ,HA-240MITI	1	0	1	A	P 1	555	5-15-P-1	
16	集団母蛾検査装置用 ,Centrifugal Settling Apparatus ,Model: H-100E , Type : TOKU	1	0	1	A	S 1	659	5-16-S-1	
17-1 -2	集団母蛾検査装置用顕微鏡 ,Microscope ,Type : KP	2	0	2	A	S 2	222	5-17-1-S-1 5-17-2-S-2	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing Section, P:Pathology Section, S :Silkworm Seed Technology Laboratory, C:CSR&TI, T:CSTRI

No.	Name of Equipment Including Its Model, Capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utilization	Place Kept	Unit Price in ¥ 1,000	Number in Sticker	Remarks
18	浸透圧計用ﾌﾟﾘﾝﾀｰ , Printer ,Model :P-180 for Osmotic Pressure Meter ,Model:OM-801	1	0	1	A	M 1	294	5-18-M-1	
19-1 -2 -3	動力ざ桑機 , Leaf Chopper ,Model : KC-4	3	0	3	A	S 1 , R 2	651	5-19-1-S-1 5-19-2-R-1 5-19-3-R-2	
20-1 -2 -3 -4 -5	赤外線水分計 ,Infrared Moisture Meter , Model : FD-230	5	0	5	A	B 1 ,P 1 ,R 1 ,M 1 , S 1	585	5-20-1-B-1 5-20-2-P-1 5-20-3-R-1 5-20-4-M-1 5-20-5-S-1	
21-1 -2	張力計 ,Tension Meter ,Model : Te - 11	2	0	2	A	T 2	1,484	5-21-1-T-1 5-21-2-T-2	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing Section, P:Pathology Section S:Silkworm Seed Technology Laboratory, T: CSTRI

Utilization of Equipment & Machinery Provided by JICA in 93/94
As Unaccompanied Baggages
Costing More Than ¥1 Lakh and Less Than ¥16 Kakhs

31/8/94

No.	Name of Equipment Including Its Model, Capacity etc.	Nos Provided	Nos Disposed	Nos Existed	Utilization	Place Kept	Unit Price in ¥ 1,000	Number in Sticker	Remarks
K-01	ワードプロセッサー,Word Processor NEC Bungou Mini 15SV	1	0	1	A	C 1(Leader's Room)	194	5-K-01-C-1	
K-02	ワードプロセッサー,Word Processor NEC Bungou Mini 5SH	1	0	1	A	C 1(Mulberry Expert)	174	5-K-02-C-1	
K-03	パーソナル コンピューター ,IBM THINKPAD 550BJ	1	0	1	A	C 1(Pathology Expert)	445	5-K-03-C-1	
K-04	ワードプロセッサー , Word Processor NEC Bungou Mini	1	0	1	A	S 1(SSP Expert)	173	5-K-04-S-1	

M:Mulberry Cultivation Section, B:Breeding Section, R:Rearing Section, P:Pathology Section, S:Silkworm Seed Technology Laboratory, C:CSR&TI

Annex 6

Local Cost Affairs of JICA (US $)

Fiscal Year	General Expenses	Total	Remarks
91	25,350.78	25,350.78	
92	70,360.98	70,360.98	
93	65,180.57	65,180.57	
94	95,000.00	95,000.00	
Total	255,892.33	255,892.33	

ANNEX 7

Posting of Indian Counterparts(1)

Project site Name & Section		Part time/ Full Time	Period
I Silkworm Breeding Technology (CSR&TI, Mysore)			
Dr. S.N. Chatteerjee	J.D.	Part Time	From 7/1991 to 1/1994
Dr. M.M. M.N.S.Iyengar	J.D.	Part Time	From 2/1994 to 6/1994
Dr. M.M. Ahsan	J.D.	Part Time	From 7/1994
a. Mr. C.S. Nagaraja	D.D.	Full Time	From 7/1991 to 2/1992
b. Mr. H.K. Basavaraja	D.D.	Full Time	From 7/1991
c. Mr. Mallikarjuna	SRO	Full Time	From 7/1991 to 3/1992
d. Mr. S. Nimal Kumar	SRO	Full Time	From 7/1991
e. Mrs. Kshama Giridhar	A.D.	Part Time	From 4/1993
f. Dr. N.Mala Reddy	SRA	Full Time	From 7/1991
g. Dr. Suresh Kumar	SRA	Full Time	From 10/1992
h. Dr. M. Ramesh Babu	SRA	Full Time	From 4/1994
i. Dr. K.P. Jaiswal	D.D.	Part Time	From 7/1991 to 3/1993
j. Mr. M.K. Mujumder	D.D.	Part Time	From 7/1991 (Reeling Lab.)
k. Mr. H.R. Harish Kumar	SRA	Full Time	From 4/1994 (Reeling Lab.)
II Silkworm Disease Control Technology (CSR&TI, Mysore)			
Dr. M.V. Samson	J.D.	Part Time	FROM 7/1991 to 2/1992
Mr. M.N.S. Iyengar	J.D.	Part Time	FROM 3/1992
1) Pebrine			
a. Dr. Murthza Baig	D.D.	Part Time	From 7/1991
b. Dr. T.O. Sasidharan	SRO	Full Time	From 7/1991 to 9/1992
c. Dr. K.V.V. Ananthalakshmi	SRA	Full Time	From 7/1991
d. Mr. S. Nageswara Rao	SRA	Full Time	From 7/1991
2) Virus			
a. Mr. B. Nataraju	D.D.	Full Time	From 7/1991
b. Dr. V. Shivaprasad	SRA	Full Time	From 7/1991
c. Mr. T. Selva Kumar	SRA	Full Time	From 4/1994
III Silkworm Rearing Technology (CSR&TI, Mysore)			
Dr. C.K. Kamble	J.D.	Part Time	From 4/1994
a. Dr. R.K. Rajan	D.D.	Full Time	From 7/1991
b. Dr. Vinod B. Mathur	SRO	Full Time	From 7/1991
c. Dr. K.L. Joshi	SRO	Part Time	From 7/1991 to 12/1991
d. Mr. M.T. Himantharaj	SRO	Part Time	From 8/1992
e. Dr. G.B. Singh	SRA	Full Time	From 7/1991
f. Dr. G.P. Singh	SRA	Part Time	From 4/1994
g. Miss A. Meenal	SRA	Full Time	From 8/1992
IV Mulberry Breeding & Cultivation Technology (CSR&TI, Mysore)			
Dr. A. Sarkar	J.D.	Full Time	From 7/1991
1) Mulberry Breeding			
a. Miss Mala Rajan	SRO	Part Time	From 7/1991
b. Mr. R. Balakrishna	SRO	Part Time	From 7/1991
c. Dr. T. Mogili	SRA	Full Time	From 7/1991
2) Mulbery Cultivation			
a. Dr. Ramakant	SRA	Full Time	From 7/1991
b. Mr. S.A. Aqueel	SRA	Part Time	From 7/1991

Posting of Indian Counterparts(2)

Project site Name & Section		Part time/ Full Time	Period
V Silkworm Seed Production Technology (SSTL KODATHI & SSPC Bangarole)			
Dr. Chandrashekharaiah	J.D.	Part Time	From 7/1991
1) Silkworm Egg Preservation and Production Technology			
a. Dr. A. Manjula	D.D	Part Time	From 7/1991
b. Dr. G. Vemananda Reddy	SRO	Part Time	From 7/1991
2) Seed Crop Rearing Technology			
a. Dr. Puttaswamy Goda	D.D.	Full Time	From 7/1991
b. Dr. R.N. Datta	SRO	Part Time	From 7/1991
3) Pebrine Control Practives for Seed Production Centre			
a. Dr. T.O. Sashidaran	SRO	Full Time	From 9/1992
b. Dr. R.N. Singh	SRO	Part Time	From 7/1991
c. Dr. Tribhuvan Singh	SRO	Part Time	From 7/1991
4) Mass Production Technology for Silkworm Eggs-1			
a. Shri B.S. Angadi	A.D.	Full Time	From /1991
b. Dr. N.M. Biram Saheb	SRO	Full Time	From 7/1991
c. Smt. B.S. Vijayalaksmi Rao	SRO	Full Time	From 7/1991
d. Mr. Vijaya Kumar	STA	Full Time	From 7/1991
VI Silk Reeling Technology (CSTRI & SCTH BANGAROLE)			
1). Cocoon Testing, Drying, Storage & Reeling(CSTRI)			
a. Shri. B.M. Lakshmipathaiah	D.D.	Part Time	From 7/1991
b. Shri. Bhanuprakash Raj	SRO	Full Time	From 7/1991
c. Shri. G. Hariraj	SRA	Part Time	From 7/1991
d. Shri. Sudhash V. Naik	SRA	Part Time	From 7/1991
2) Silk Testing(SCTH)			
a. Shri. S.S. Ghosh	J.D.	Part Time	From 7/1991
b. Shri. Chockalingam	SRO	Full Time	From 7/1991
c. Shri. Ashwanth Reddy	SRA	Full Time	From 7/1991
d. Shri. Sanjay L. Chilakwad	SRA	Full Time	From 7/1991

J.D.: Joint Direcror
D.D.: Deuty Dorector
A.D.: Assistant Director

SRO : Senior Research Officer
SRA : Senier Research Assistant
SRA : Senier Technical Assistant

Annex 8

Progress Situation of Project Activities

1. DEVELOPMENT OF SILKWORM BREEDING TECHNOLOGY(1)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
(1) Preparatory investigation a) Field survey	———	———				Identification of difficult aspects of Indian, environment, defects of Indian hybrids & breeds.	A	Field survey was executed at some areas of traditional sericultural states viz. Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal and Uttar Pradesh. Under new sericultural states, few places have been covered. It has been observed that many farmers are rearing parental bivoltine and the cross breed(Multi × Biv.).	Field survey in new sericultural area will be done, if necessary. North-East region & Jammu and Kashmir can be surveyed depending on the prevailing situation.
b) Evaluation of existing breeds	———	———				Identify the weakness of Indian bivoltine breeds and scope of improvement. Adoption of plan to improve specific characters in Indian bivoltine breeds.	A	It is indicated ; a) Among the existing popular breeds, the performance of NB4D2 was satisfactory, whereas the performance of oval breeds was not satisfactory. b) More emphasis should be given during breeding in developing good oval lines to match with dumbbell lines for hybrid exploitation.	In addition to NB4D2, some more new dumbbell lines are to be evolved.
c) Evaluation of existing hybrids	———	———				Identify the weakness and determine the area needing attention for improvement.	A	It is indicated that; a) Small quantity of bivoltine hybrids rearing was noticed. Good cocoon yield was recorded in good season. b) New authorization system of hybrids for commercial rearing is proposed.	Identification of suitable hybrids will be continued with Indian counterparts.

1. DEVELOPMENT OF SILKWORM BREEDING TECHNOLOGY(2)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
(2) Development of breeding plan designing methods a) Evaluation of breeding plans	———	———	———			Identification of defects and short-comings in earlier breeding plans.	A	Most of the inbred lines were extracted from commercial hybrids of Japan, Russia, China and South Korea. A few breeds evolved by crossing with oval x oval and dumbbell x dumbbell. The breeds extracted from F1 hybrids will depict low heterosis.	
b) Breeding strategy development	———	———				Identify the most suitable breeding plans.	A	The commercial hybrids introduced from Japan were crossed with Indian breeds for evolution of superior inbred lines through backcross breeding. Oval and dumbbell lines were selected from crosses of oval x oval and dumbbell x dumbbell. During breeding, incubation, rearing aspects, selection, cocoon assessment and reeling traits (related to breeding) were taken into consideration.	The breeds developed from this technique are once again crossed with new breeds/ hybrids for further improvement of quantitative traits. These breeding lines(38 lines) will be subjected for selection breeding during favourable seasons viz., Nov.~Oct.1994, Jan.~Feb.1995, Sept.~ Oct.1995 and Feb.1996. Hybrid evalution, Sept.~Oct.1996, Dec~Jan.1996 and Feb.1997. More number of oval and dumbbell breeds will be developed.

1. DEVELOPMENT OF SILKWORM BREEDING TECHNOLOGY (3)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
(3) Development of pure line breeding technology a) Breeding for robustness		———	———	———	———	Development of robust and high yielding silkworm breeds tolerant to Indian environmental condition.	B	Keeping pupation scale, breeding lines with robustness have been selected. As suggested by short term expert, a few breeding lines with higher pupation rate were initiated. Race — Survival(%) 1 — 2 121 dumbbel — 92.0 — 96.0 NB4D2 x CC1 — 82.0 — 97.0 NB4D2 x CA2 — 75.0 — 95.0 MBC2 x NB4D2 — 85.0 — 92.0 MBC1 x B9 — 70.0 — 97.3 KA x NB4D2 — 75.0 — 95.1 1. Reared at 36℃ 6hrs/day 2. Reared at room temp. (25℃)	The new breeding lines and their hybrids will be subjected for high temperature tolerance. The tolerant breeds will be used as breeding resource materials and the hybrids will be tested in hig htemperature areas.
b) Breeding for high silk content	———	———	———	———	———	Evolve breed(s) with high silk content.	A	a) Breeeding lines which were initiated during Sept. 1991 by crossing Japanese hybrids with Indian breeds are at F10 generation. Utilising the germplasm breeds(CSR&TI) as breeding materials, a few breeding lines were initiated (See 2b). Hybrid — Survival — SR% A6 x B9 — 95.0 — 21.6 A25 x B24 — 91.0 — 21.4 A21B x NB4D2 — 86.0 — 23.3 A20A x B21B — 80.0 — 24.5 KA x NB4D2 — 86.1 — 20.2 (Existing Hybrid)	Selection will be continued.

1. DEVELOPMENT OF SILKWORM BREEDING TECHNOLOGY (4)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
								b) The hybrids obtain from different breeding centres of Japan were used as breeding materials for improvement of silk content and new lines have been initiated. Presently these lines are at F4(38 lines).	Selection will be continued.
c) Breeding for high silk quality	———	———	———	———	———	(a) Removal of defects in existing Indian commercial bivoltines.	B	Existing breeds and new breeding lines were subjected for test reeling characters in every generation.	Selection of fibre quality will be continued.
	———	———	———	———	- - - - -	(b) Evolve breed with high silk quality having 90~92% neatness and better uniformity of fibre.		Reeling technique for small quantitiy of cocoon was demonstrated. Besides, mono-cocoon reeling method was adopted for selection of breeding lines with fine denier with less deviation.	Selection will be continued. Breeding for thin denier to be initiated

Hybrid	Neatness	Hybrid	Neatness
A6 x B9	95.0	MBC1 x MBN1	92.0
A25 x B24	90.5	A21A x NK25	95.5
MBC2 x B24	96.0	KA x NB4D2	90.0
MBC2 x MBN2	95.0		

Breeding for low boil off loss was also carried out.

Breed	Boil off loss	Hybrid	Boil off loss
A6	24.7(%)	NB4D2 x CC1	24.9
B25	25.5	NB4D2 x KA	24.9
A25	26.1	B9 x A6	24.6
NB4D2	25.8	B24 x A25	26.5
		A21 x J14	26.5

1. DEVELOPMENT OF SILKWORM BREEDING TECHNOLOGY (5)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
d) Development of breed maintenance method						Develop a suitable breed maintaining method to maintain the developed breeds conforming to the norms fixed at the time of fixation of breeds	B	After field survey, it was observed that the maintenance of approved breeds was not satisfactory. Guideline regarding the maintenance/ multiplication of breeds were prepared and circulated.	After development of new breeds, maintenance/ multiplication methods conforming to the breed characteristics will further be discussed.
(4) Development of hybridization techniques a) Development of combining methods						Identification of potential hybrids.	B	After F6 generation, all the breeding lines were subjected for hybrid testing. The promising hybrids were shortlisted for further testing. The parent breeds of non-selected hybrids are being changed. Four hybrids J14 x A21, A21 x NK26, B9 x A6 and A25 x B24 were selected on the basis of evaluation index. Bisides, on the basis of evaluation index of 4 hybrids have been selected with high cocoon shell ratio(above 25%); CSR2 x CSR5, CSR2 x CSR4, CSR3 x CSR6 and CSR12 x CSR6.	The good combiners will be sorted out. Testing of selected hybrids at farmers/RSRS/Regional Extention Centres will be conducted. Identification of productive hybrids with cocoon shell ratio 23-25% will be continued.
b) Studies on hybrid evaluation methods						Identify hybrid(s) with a. High survival and yield. b. High silk content. c. High silk quality.	B	Eventhough there are different methods adopted to evolve hybrids for immediate analysis, the evaluation index method developed by the Japanese expert is followed.	The identified hybrids viz, A6 x B9, A25 x B24, A21A x MBN2 and MBC2 x MBN1 will be evaluated in different branch stations of Main Research Institute and other Research Institutes.
c) Selection of hybrids						Identify hybrids suited to hill and plain areas and seasons.	B	After authorization, the selected hybrids will be subjected for testing.	Identified hybrids will be tested in good season on both at hilly and plain areas.

2. DEVELOPMENT OF SILKWORM DISEASE CONTROL TECHNOLOGY (1)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
(1) Field Survey a) Field survey						Preparation of model forewarning	B	Prevalence of silkworm diseases were identified. Actual and seasonal change in pebrine incidence was studied. Prevalence of infectious flacherie and densonucleosis was established. Survey on the prevalence of BmIFV, BmDNV1 and BmNPV was completed. Data analysis is under progress.	Model for disease forecasting will be developed.
(2) Development of diagnostic method for viral diseases a) Collection and isolation of viral						Purification and identification of viruses	B	Isolation, multplication and purification of BmIFV and BmDNV1 were completed.	Collection and characterisation of BmDNV2 will be carried out.
b) Standardisation of bioassay methods for viral pathogens						Characterisation of virus infectivity	B	Bioassay method for BmIFV and BmDNV1 infectivity was standardised and IC50 values were calculated. Synergestic effect of BmIFV and Enterococcus in the causation of flacherie was estimated.	Standardisation of bioassay method and caluculation of IC50 for BmIFV2 will be carried out. Synergestic effect of BmIFV and other bacteria will be studied.
c) Studies on virological diagnosis techniques						Development of diagonostic kit suitable for detection of viral diseases.	B	Anti-BmIFV IgG was purified and charcterised. Immunodiagnostic assay were developed for the detection of BmIFV.	Field trials of immunodiagnostic assays for the detection of BmIFV will be conducted.

2. DEVELOPMENT OF SILKWORM DISEASE CONTROL TECHNOLOGY (2)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
(3) Development of control measures against viral diseases									
a) Infectivity and pathogenicity tests			———	———		Determination of infectivity, loss of virulence and pathogenicity to different instars of silkworm.	B	Infectivity, pathogenicity of BmIFV and BmDNV1 were studied.	Infectivity, pathogenicity and virulance of BmDNV2 will be studied.
b) Studies on disinfectant techniques			———	———	———	To identify disinfectant/bed disinfectant suitable for Indian rearing conditions against viral disease	B	Effectiveness of different disinfectants against BmNPV polyhedra in the disinfection of rearing trays smeard with cowdung was studied.	Investigations of disinfectants and fomulations of bed disinfectant against BmIFV, BmDNV1 and BmDNV2 will be continued. The mistake in the use of cowdungin the silkworm rearing will be point out.
c) Development of manual for viral disease control				———	———	To prepare a manual for control of viral diseases with sericulturists	C	Studies on items (1) - (3) are under progress. Fundamental guidance was contributed through the magazine "Indian silk"	Standard manual on silkworm viral diseases will be prepared.
(4) Development of diagnostic methods for microsporidian diseases									
a) Collection and isolation of pathogenic microsporidian	———	———	———	———		Collection and purification of microsporidians infecting silkworm and agricultural pests.	B	Collection and isolation of different microsporidians from silkworm and butterflies were continued. New microsporidians ; NIK-2r, NIK-3hNIK-4m NIK-im(1) and Pleistophora spores were collected from silkworms. Microsporidians were collected and isolated from butterflies.	Collection and isolation of pathogenic microsporidians will be continued.

2. DEVELOPMENT OF SILKWORM DISEASE CONTROL TECHNOLOGY (3)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
b) Identification of microsporidians	———	———	———			Morphological and histopathological identification of microsporidians.	B	Morophological and histopahtological identification of isolated microsporidiands was completed.	Morphological and histopathological identification of newly isolated microsporidians will be studied.
c) Studies on serological techniques	———	———	———			Development of diagnostic kit for identification of different microsporidians	C	Strain differentiation was done using species specific monoclonal antibodies. Spore surface protein of N. bombycis and NIK-4m was isolated for the generation of monoclonal antibodies.	Monoclonal antibodies for different isolated microsporidians will be generated.
(5) Development of control measures against microsporidan diseases									
a) Infectivity and pathogenicity tests	———	———	———			Determination of infective dosage and also mode of transmission of different microsporidians	A	Infectivity and pathogenicity of 4 microsporidians was determined. Transovarial transmission studies on NIK-1s and NIK-2r were completed. The studies on NIK-3h and NIK-4m are under progress.	Frequency distribution of developmental stages during egg incubation will be studied. Transovarial transmission of NIK-3h and NIK-4m will be continued.
b) Studies of disinfection methods		———	———			Identification of suitable disinfectant/ chemical against microsporidians	B	Efficacy of disinfectants viz., chlortech, steridol, formalin and bleaching powder was studied at different temp. and as egg surface disinfectants. The effectiveness of different disinfectants against N. bombycis spores in the disinfection of rerearing trays smeared with cowdung was studied.	Studies on disinfectants will be continued.

2. DEVELOPMENT OF SILKWORM DISEASE CONTROL TECHNOLOGY (4)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
c) Development of manual for microsporidian disease control		———	———	———		To prepare a manual for control of microsporidian disease	B	Studies on items (4) and (5) as above are under progress.	Standard manual for farmers and extension workers on control of microsporidians will be prepared.
d) Development of pebrine inspection technique	———	———				Development of suitable pebrine insepection technique for detection of infection	A	Data was collected from 1990 onwards for sampling method. Based on the data, methods of sampling and inspection for pebrine were developed. Training and demonstrations were conducted. Inspection manual was prepared.	

3. DEVELOPMENT OF SILKWORM REARING TECHNOLOGY(1)

Item of Work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of Achievement	Score	Present Status and Attainment	Activities in Remaining Period
(1) Development of silkworm rearing technology for young age worm									
a) Field survey	———	———	———			Identification of defects / field problems.	A	Field survey of various agro-climatic zones of India such as Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Uttar Pradesh, Rajasthan and West Bengal were taken up. Various field problems were identified.	Further survey will be taken up if required.
b) Examination of food value of mulberry leaves	———	———	———	———		Identification of suitable mulberry varieties for young age rearing.	A	Evalulation of 13 Indian mulberry variaties were done by bio-assay method. Mulberry varieties in the order of merit were identified.	More trials will be conducted confirm the findings.
c) Development of rearing methods		———	———	———		Development of suitable rearing method for Indian environmental conditions.	A	Seven methods of chawki rearing viz., chamber covering, chamber wrapping, room pileup covering, room pileup wrapping, stand covering, stand wrapping and contarol with foam pads were done during different seasons.	Further studies on rearing in chamber is required
d) Development of rearing manual				———	———	Standardisation of rearing technology for young age rearing by following (a), (b) and (c).	C	Preparation of rearing manual for young age rearing is under progress.	Rearing manual for farmers and co-operative rearing hauses will be available at the end of the project.

3. DEVELOPMENT OF SILKWORM REARING TECHNOLOGY(2)

Item of Work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of Achievement	Score	Present Status and Attainment	Activities in Remaining Period
(2) Development of rearing technology for late age silkworm									
a) Field survey	———	———				Inditification of field problems/defects in late age rearing.	A	Field survey of various agro-climatic zones of India such as Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Uttar Pradesh, Rajasthan and West Bengal were taken up. Various field problems were identified.	Further survey will be taken up if required.
b) Examination of foodvalue of mulberry leaves	———	———	———	———	- - - - -	Identification of suitable mulberry varieties for late age.	C	Evaluation of 13 Indian mulberry varieties were done by bio-assay method. There was no significant differrence between varieties. However V2. V3, G3 and S36 were found to be better in some of the characters.	Two more trials for rainy and winter season has to be taken up.
c) Development of transport and storage method of mulberry shoots		———	———	———		Development of suitable transportation and storage method for mulberry shoots.	B	Various transpotation methods like, by tiller, by manual and by covering with polythene sheet, gunny cloth, urea bag and open were studied for 30 minutes distance. Different preservation methods also tried. During rainy season no significant difference was observed	Summer trial has to be taken up.
d) Studies on feeding methods	———	———	———	———		Identification of ideal method of feeding and feeding frequency.	A	Feeding methods like leaf feeding, shoot feeding, different feeding frequency and feeding different types of leaves like tender, medium and coarse were studied. No significant difference was noticed among 2, 3 and 4 feeds. Hence 2 or 3 feeds can be recommended instead of 4 feedings for shoot rearing.	Further studies on amount of feeding in Vinstar will be taken up.

3. DEVELOPMENT OF SILKWORM REARING TECHNOLOGY(3)

Item of Work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of Achievement	Score	Present Status and Attainment	Activities in Remaining Period
e) Studies on rearing environmental maintenance	———	———	———			Identify the methods for maintenance of ideal temperature and humidity in rearing house.	C	Late age larvae were reared under different environmental conditions in sericatoron to find oust the effect on cocoon quality.	Further trials are required before concluding.
		———	———	———	- - - - -				
f) Field trials			———	———		Identification of rearing methods suited to different agroclimatic regions.	B	One field trial was taken up in April 93 by supplying chawki worms and compared with laboratory rearing. Farmers harvested 44.4㎏/100 dfl's compared to lab 46.4㎏ during summer season.	Further field trials were planned.
			———	———	- - - - -				
g) Development of rearing manual				———	———	Standardisation of rearing technology for late age rearing by following (a-e).	D	Preparation of rearing manual is under progress.	Rearing manual for farmers will be available by the end of the project.
			———	———	- - - - -				
(3) Development of mounting and cocoon harvesting technology									
a) Development of apparatus and mounting techniques	———	———	———			Identification of suitable mountage and mounting methods suited to Indian conditions.	A	Plastic bottle brush mountage was developed and a comparative study of different mountages and different mounting methods like, Jobarai, self and pickup methods and mounting on different days were studied.	One more trial will be taken up before concluding the expriment.
	———	———	———	- - - - -					
b) studies on the environmental conditions for mountig		———	———			Identification of effect of temperature and humidity on spining.	C	Silkworm spinning at different temperature were done. 24℃ has given better cocoon characters.	Further studies are required before concluding the experiment
			———	———	- - - - -				

3. DEVELOPMENT OF SILKWORM REARING TECHNOLOGY(4)

Item of Work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of Achievement	Score	Present Status and Attainment	Activities in Remaining Period
c) Development of apparatus and technology for cocoon harvest		———	———	----		Development of suitable harversting mathod.	B	Use of cocoon harvesting machine for rotatory mountage bottle brush mountage and seri frame to harvest cocoon in compaison to manual harvesting was studied.	Further studies are required.
d) Development of mounting and cocoon harvesting manual			———	———		Standardisation of mounting and harvesting technology by following (a)-(c).	D	Manual for mounting and harvesting will be prepared after concluding all the experiments.	Manual for farmers will be made by the end of the project.

4. DEVELOPMENT OF MULBERRY BREEDING AND CULTIVATION TECHNOLOGY(1)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
(1) Development of mulberry technology for young age silkworm									
a) Studies on breeding methods for young age bivoltine silkworm						To develop suitable mulberry varieties for young age silkworm through different breeding techniques.	A	Four times artificial crossing using the genetic resoruces of the CSR&TI was conducted since 1991. A total of 63 cross combinations were tried.	Artificial crossing between different parents of Indian and exotic origin will be continued. Effective cross combinations are to be clarified.
b) Screening and selection						To standardise the nursery selection procedure.	B	Raising of the hybrid plants and measurement of their econo-mic characters have been carried out. Adaptability of existing varieties to young silkworms were examined. Out of existing varieties, an excellent line was selected.	The selection will be continued. Adaptability of existing varieties and lines to young age silkworm will be clarified. Effective selection method is to be clarified.
c) Development of mulberry cultivation technology						To establish an agronomical package with respect to spacing, manuring & irrigation.	A	Effects of the planting space and fertilizers on mulberry growth and yield are under testing. Effect of the planting space on feeding value was examined.	Effects of the various agronomical conditions on the mulberry growth and yield will be clarified. An agronomical package for mulberry cultivation for young age silkworm will be developed.
d) Development of harvesting & transporting method						To establish efficient harvesing & transporting system to keep the leaves fresh.	C	The experimental field was prepared and preliminary measurement was done.	Various growing method of mulberry for young age silkworm will be tested. Transporting method of harvested leaves will be developed in collaborate with RTI.
e) Field trials						To identify region specific varieties.	C	Data collection on the region specific varieties is being done.	On selected region specific varieties, the suitability to chawki mulberry will be clarified.
f) Development of standard technical						Compilation of all recommendations.	D	Studies from a)-e) are currently under progress.	Recomendation will be compiled and standard manual will be published.

manual								

4. DEVELOPMENT OF MULBERRY BREEDING AND CULTIVATION TECHNOLOGY (2)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
(2) Development of mulberry technology for late age silkworm									
a) Field survey						To understand the existing practices	B	Informations are being collected on existing cultivation practices in India.	In the selected area, more detail survery on the farmers' practices will be done.
b) Studies on the breeding methods						To develop suitable mulberry varieties for late age silkworm through different breeding techniques.	A	Same as 1(a).	Same as 1(a).
c) Screening and selection						Standardisation of selection procedure.	B	Seedlings were growing and selection for late age silkworm is being made. Selected seedlings are under multiplication for line selection.	The selection of superior varieties will be continued for late age silkworm. Suitability for shoot cutting harvest will be tested on existing varieties and lines. Effective selection method will be clarified.
d) Development of cultivation technology						To establish an agronomical package for mulberry cultivation for late age silkworm.	C	To clarify the effects of the agronomical conditions on mulberry growth and yield, an experimental field was established and preliminary measurement was done.	Effects of the agronomical conditions will be clarified. An agronomical package of mulberry cultivation for late age silkworm will be developed.
e) Development of harvesting and transportation method						To establish efficient harvesting & transporting system to keep the leaves fresh.	C	An experimental field for harvesting methods was established and preliminary measurement was done.	Efficient shoot harvest method will be established. Transporting system will be developed in collaboration with silkworm rearing section.

4. DEVELOPMENT OF MULBERRY BREEDING AND CULTIVATION TECHNOLOGY (3)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities on Remaining Period
f) Studies on improvement of existing cultivation practices	———	———	———			To develop innovated technology for existing mulberry fields.	B	Using existing mulberry field, an improving method which consist of fertilizer, training and harvest method is under testing.	A method which can improve yield and quality of existing mulberry will be developed.
			———	- - -	- - -				
g) Field trial			———	———		To transfer the package with selected varieties in different agro-climatic zones.	C	Data on the regional adaptability of mulberry varieties are being collected.	Region specific mulberry varieties will be recomended.
				- - -	- - -				
h) Development of standard technical manual				———	———	Compilation of all recommendation.	D	Studies from a)-g) are currently under progress.	Recommendation will be compiled and standard manual will be published.
				- - -					

5. DEVELOPMENT OF SILKWORM SEED PRODUCTION TECHNOLOGY(1)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
(1) Development of bivoltine egg preservation technology									
a) Studies on the silkworm eggs	———	———	———	———	- - -	Identification of suitable embryonic stage for preservation of diapausing eggs	A	Technique for isolation of different stages of embryo has been standardised. The growth and developmental sequence of embryos of different races under optimal condition has been studied and the time table of defferent embryonic stages has been drawn. Studies on the developmental sequence of embryos under varied climatical conditions are under progress.	The embryonic growth rate studies at different temperatures and relative humidity will be continued. Embryonic stages suitable to cold storage and release of diapause eggs will be undertaken.
	———	———	———	———	- - -	Determination of physiological and biochemical changes during hibernation	B	Quantitative analysis of proteins and glycogens in bivoltine eggs preserved under varuous schedules has been conducted.	Similar studies will be continued to determine biochemical profiles associated with the termination of dalpause and ubsequent embryonic development.
b) development hibernation techniques	———	———	———	———	- - -	Formulation of specific schedules for different period of preservation	B	Presently popular parent races NB4D2, CC1 and KA were used for experiment. The aestivation period was 20~60 days and cold storage durationwas 60~110 days with the combination of both, the total duration of preservation was 101~191 days. Thirty batches were kept in different schedules and each race hachability was observed.	Inorder to obtain effective hatchabilty within 2 days, either the cold storage duration or condition of light acid treatment will be examined. From the results, optimal hibernation schedule which suitable for different period of preservation is estimated.
c) Development of chilling and acid treatment method	———	———	- - -	- - -	- - -	Development of a schedule for short and long term chilling and acid treatment	B	This experiments have been carried out by useing cold storage facilities in CSR&TI, mysore.	Studies on different combinations of chiling periods and acid treatment for short and long term release of eggs will be carried out.

5. DEVELOPMENT OF SILKWORM SEED PRODUCTION TECHNOLOGY(2)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
d) Development of preservation schdules		———	———	———		Standardization of schedules for short and long term preservation of eggs	C	Studies from a-c are currently under progress.	Studies as indicatied above from a-c will be conducted to ultimately frame a preservation package for diapausing eggs.
(2) Development of seed crop rearing techniques a) Development of mulberry package for seed crop rearing		———	———	———		Package of practices of mulberry cultivation for seed crop rearing	A	Mulberry plantation with S36, TR10 and S13 varieties by adopting Indo-Brazilian and Indo-Japanese spacing schedules has been established and biomass studies under different pruning conditions have been conducted. Bio-assay studies are under progress.	Few more trials of biomass studies and bioassay will be carried out.
b) Development of young and late age silkworm rearing technology for seed crops		———	———	———		Standardisation of seed crop rearing technology	B	Moulting test is being conducted in order to evaluate the feed value of different mulberry varieties and to find out the mulberry varieties suitable to young age silkworm.	Elaborate studies on the influence of mulberry variety, rearing spacing, quality and quantum of feed regulation, etc., will be accomplished.
(3) Development of pebrine control practices for seed production centres a) Field survey	———	———	———			To forewarn occurrence of pebrine in seed area, in different seasons in order to take appro-priate control measures	A	Regular seasonal surveys to record the incidence of pebrine disease during different seasons at all the stages of basic seed multiplication, besides commercial seed production centres have been carried out in the State of Tamilnadu and Andhra Pradesh.	Survey will be continued for another 1 year and the survey data will be analysed to identify the seasons of occurrence and intensity of infection inrelation to season. A forewarning package will be developed.

5. DEVELOPMENT OF SILKWORM SEED PRODUCTION TECHNOLOGY(3)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
b) Development of sampling and moth examination technology						Standard procedure of sampling and examination of mother moths for accurate detection of pebrine disease	A	Standard mother moth examination technique is popularized by demonstration and by extending training to the graineurs of State Department of Sericulture, Central Silk Board and Licensed Seed Preparer s. This standard testing method is being followed in all Commercial grainages. The sampling techniques of mother moth is also been initiated.	The evaluetion of the sampling technique suggested by the expert will be continued and compared with the existing sampling procedure.
c) Development of pebrine control package for seed production centres						Development of moth examination system for production of basic and commercial seed	A	Mother moth examination technique has been standardised and implemented in the field. A manual on moth examination technique for the benefit of the Basic/Commercial Seed Production Centres has been prepared.	A comprehensive manual incorporating all the other details including sampling technique will be prepared.
(4) Development of mass egg production technology ofbivoltine eggs a) Development of loose egg production						To develop standard technique for loose egg preparation	A	Loose egg production has been standardised. Equiments required for systematic production of loose egg have been fabricated which includes egg wash-ing tray, egg drying unit, winnowing unit, loose egg packing and incubation cover, etc. The preparation of manual/guidelines on loose egg production incorporating all the detils is under progr ess.	Large scale loose egg production will be popularised. Separation of unfertilized eggs and standardisation of egg number for different seasons will also be attempted.

5. DEVELOPMENT OF SILKWORM SEED PRODUCTION TECHNOLOGY(4)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
b) Studies on incubation method						To standardize the method of incubation under tropical condition	B	The incubation of eggs under optimal and varied climatic conditions has been conducted. The studies with regard to embryonic development and hatching of the experimental batches are under progress.	After analysing the effect of temperature during incubation the promising batches will be subjected for bio-assay studies to evaluate the rearing performance.
c) Development of packing and transportation techniques of eggs						To develop the egg transportation techniques	B	Loose egg packing and incubation covers have been developed. Further, egg transportation boxes of various capacities have also been fabricated. The developed equipments have been supplied to NSSP for testing the practial utility.	Attempts will be made for futher improvisation of loose egg adhesive covers and transportation boxes.
d) Field trials						For improving the existing method of bivoltine egg production	B	The egg production techniques has been demonstrated in seed production centre of NSSP and different grainages of State Sericulture Departments. Besides, training in the large scale production of loose eggs has been conducted for the benefit of graineurs. Under this programme, a total of 48 officials including Licensed Seed Preparers were trained.	Follow-up on the production of loose eggs in the commercial granages will be taken-up by extending the necessary technical guidance to the graineurs.
e) Development of production programe and package for seed production centre						Preparation of guidelines and planning programme for bivoltine seed production	B	Comprehensive guidelines on loose egg production techniques is beening finalised.	A guideline (planning programme on loose egg production will be pulbished and communicated to all thegraninages for large-scale production of loose eggs in Commercial Grainages.

6. DEVELOPMENT OF SILK REELING TECHNOLOGY(1)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
(1) Development of cocoon testing, drying and storage technology a) Field survey						Collection of information pertaining to the existing method and problems theron to achieve quality and productivity.	A	The present conditions are being understood.	Field survey may be done when necessity arises by Indian counterparts.
b) Development of cocoon testing programme						A cocoon testing programme suitable to Indian condition would be developed	A	Standard methodology has been evolved by CSTRI and booklet has been prepared. Multiend reeling machine for cocoon testing has been set up.	CSTRI and its DCTCs are following the standard method of cocoon testing. Introduction in the field will be taken up. Useing the new reeling machine, cocoon testing method will be developed.
c) Development of cocoon drying and storing technology						To optimise the conditions of hot air drying vis-a-vis storing of cocoons	B	Standard method of hot air drying has been evolved.	Appropriate drying technology will be propagated in the field. Methodology for storage has to be introduced.
(2) Development of reeling technology a) Field survey						Understanding of the existing level of technology and problems in the processing for concieving the project	A	Present conditions are being understood.	Field survey may be done when necessity arises by Indian counterparts.
b)Development of cocoon cooking techniques						To devlop, appropriate cooking method suitable to Indian bivoltine cocoons	B	Appropriate cocoon cooking system for 3-pan and 2-pan has been advocated to multiend reelers.	Stationary pressurised cooking system is being developed. Propagation of 3-pan/2 pan cooking system in the field will be continued. Applied methodology for automatic cook-derived.

6. DEVELOPMENT OF SILK REELING TECHNOLOGY(2)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
c) Development of raw silk reeling technology			———	———	———	Suitable modifications of the machine and process parameters to workout approriate reeling technology for bivoltine cocoons to achieve the production of superior grade silkyarn.	B	About 200 basins of newly modified multiend reeling machine have been working successfully in the field. Denier detecting device syuitable for Indian reeling machine was developed.	Development ofappropriate reeling process parameters forIndian conditions will be taken up.
		- - -	- - -	- - -	- - -				
d) Development of raw silk re-reeling technology				———	———	To develop a proper rereeling technology so that the quality of bivoltine silk could be improved	C	Influence of pre-soaking on re-reeling performance has been studied. Permeation chamber provided from JICA has been set up.	Development of soaking chemicals and permeation chamber will be takenup. Influence of re-reeling process parameters on quality of silk will be studied.
			- - -	- - -	- - -				
(3) Development of silk testing technology									
a) Field survey	———	———				To understand the existing testing procedures and the quality of Indian silk	A	Present conditions are understoodnd.	Field survey may be done when necessity arises by Indian counterparts.
	- - -								
b) Studies on raw silk conditioning method※	———	———	———			Standardization of raw silk conditioning method for implementation in raw silk markets	B	Facilities have been set up. Technology has been understood.	Extension work to popularise testing is to be started vigorously by Indian counterpats through the SCTH in different placaes.
		- - -	- - -	- - -	- - -				
c) Studies on raw silk testing and grading programme	———	———	———			To evolve suitable testing and grading methods for Indian silk	B	Testing of raw silk by scoring for looks, breaks counting and size deviation started in 1992. The properties by Indian reelers, weavers and traders is being tested.	Testing of other properties of silk is to be persued.
	- - -	- - -	- - -	- - -	- - -				

6. DEVELOPMENT OF SILK REELING TECHNOLOGY(3)

Item of work	1991 1st	1992 2nd	1993 3rd	1994 4th	1995 5th	Goal of achievement	Score	Present Status and Attainment	Activities in Remaining Period
d) Development of design and operational manual for silk conditioning and testing houses	———	———	———	———	- - - -	Based on the above studies evolve a suitable operational manual for SCTH	B	SCTH is working now in 5 centers. Preliminary manuals have been prepared by Indian counterparts according to the existing Indian conditions.	Facilities has to be developed in regard to Indian bivoltine raw silk. Manuals for testing and grading of raw silk are to be developed for SCTH by Indian counterparts with guidance given by short term experts.

調査団礼状

December, 19 1994

Mr. Arun Ramanathan
Member Secretary
Central Silk Board
Ministry of Textile, India

Dear Sir,

Thanks to your kind hospitality and arrangement, we, the Technical Guidance Team on the Bivoltine Sericulture Technology Development Project were able to carry out investigation of the present activities of the Project regarding its technical and managerial aspects.

Despite very limited time given to us, we could also discuss more smooth implementation of the Project from now on. We would like to extend our gratitude for our successful investigation to you and staff of Central Silk Board concerned.

We are pleased to be able to agree with you on the following points.

1) There have been many remarkable progresses on techniques developed by the Project through both Indian and Japanese efforts.
2) Transfer of techniques to Indian Counterparts has been accomplished to a satisfying extent.
3) Moreover, both Indian side and Japanese side could confirm that during remaining one and half year, for the smooth implementation of the Project, more important activities of the Project should be selected and these activities should be efficiently achieved.

We hope that the Project will progress through continuing efforts of both Indian side and Japanese side from now on.

Sincerely Yours,

河上 清

Dr.K. Kawakami
Leader
JICA Technical Guidance Team

付 属 資 料　3

プロジェクトで開発された技術

参考１　二化性交雑種の形質一覧表

参考２　飼育標準表（２種）

参考３　バラ種製造マニュアル及び母蛾検査マニュアル

参考４　製糸技術マニュアル及び繭検定マニュアル

参考１　二化性交雑種の形質一覧表

PERFORMANCE OF NEWLY EVOLVED BIVOLTINE HYBRIDS

SBL (JICA), CSR&TI, MYSORE

HYBRID 交雑種	化蛹歩合 PUP RATE (%)	繭　重 SC WT. (g)	繭層重 SS WT. (cg)	繭層歩合 SR (%)	生糸量歩合 RAW SILK (%)	繭糸長 FIL. LEN (m)	繭糸繊度 DEN IER (d)	解じょ率 REEL (%)	小ぶし NEAT NESS (p)
CSR1× CSR4	97.1	1.99	43.4	21.8	18.6	1143	2.98	87	95.0
CSR2× CSR4	98.9	2.08	52.1	25.0	20.9	1285	3.10	84	96.0
CSR2× CSR5	98.3	1.87	46.5	24.9	21.7	1246	2.96	77	93.0
CSR3× CSR6	95.7	1.92	48.3	25.2	21.1	1247	2.94	83	91.5
KA× NB4D2	95.1	1.76	35.9	20.4	17.3	1022	2.70	85	95.5

最下段の対照品種（KA×NB4D2）に比し、育成品種（４品種）は化蛹歩合高く、繭重、繭層重は重く特に繭層歩合は３品種で顕著に高くなっている。また、生糸量歩合も３品種で３～４％高く、繭糸長も200m程度長くなっている。

飼育成績を総合的にみて、上から２、３番目のCSR2×CSR4とCSR2×CSR5は良好で、日本で育成されている二化性交雑種と遜色のない品種である。特に２段目のCSR2×CSR4は良い。

参考2　稚蚕飼育標準表

Standard Table for Young Silkworm (10,000 Larvae)

齢期	日	給桑時間	作業	蚕座面積	給与桑のサイズ	給桑量(全葉)	給桑量 1日の量	齢期ごとの総量
				(m²)	(cm)	(g)	(g)	(g)
		10	掃おろし	0.1	0.5×0.5	30	140	
	1	14	整座	0.2	1×3	50		
		21				60		
		6				80		
I	2	14	拡座	0.4		100	300	
		21				120		850
26～29℃		6				100		
66～99%	3	14				100	350	
		21				150		
	4	6			1×1.5	60		
		14	拡座	0.8			60	
		9	桑付け	0.8	2×5	200		
	5	14		0.8		300	1100	
		21		0.8		600		
II		6		0.8		600		
26～29℃	6	14		0.8		600	2000	4000
		21		0.8		800		
74～99%		6		0.8		600		
	7	14		0.8	1×2.5	300	900	
		21	拡座	1.6				
		9	桑付け	1.6	3×6	600		
	8	14		1.6		800	2400	
		21		1.6		1000		
		6		1.6		1000		
III	9	14		1.6		1000	3200	
		21		1.6		1200		
24～29℃		6		1.6		1200		10400
62～96%	10	14	掃き立て	1.6		1200	3800	
		21		1.6		1200		
		6		1.6	1.5×3	1000	1000	
	11		拡座	2.6				

Standard Table for Young Silkworm (10,000 Larvae)

齢期	日	給桑時間	作業	蚕座面積	給桑量(全葉)	給桑量 1日の量	齢期ごとの総量
				(㎡)	(kg)	(kg)	(kg)
		6	桑付け	2.6	3(Leaf)		
	12	14	網入れ	(1.2×2.2)	4	15	
		21			8		
		6			10		
Ⅳ	14	14	掃き立て & 拡座	4.0	10	32	
		21		(1.2×3.4)	12		86
25～28℃		6			12		
60～70%	15	14			12	36	
		21			12		
		6					
	16	14		6.5	4	4	
		21		(1.5×4.3)			
		6					
	17	14			15	15	
		21	網入れ				
		6	掃き立て & 拡座		15		
	18	14		8.2	15	50	
		21		(1.5×5.5)	20		
		6			20		
	19	14			20	70	
Ⅴ		21			30		
		6			25		
25～28℃	20	14			25	90	410
60～70%		21			40		
		6			25		
	21	14			25	90	
		21			40		
		6			25		
	22	14			20	75	
		21			30		
	23	6			20	20	

給桑量表（1齢期：対１万頭当り）

日	給桑時間	作　業	飼育面積	標準給桑量	実際の給桑量	備　考
			(cm)	(g)		
1	10	掃おろし	30×35	30		
	14	整座	45×45	50		
	21			60		
2	6			80		
	14	拡座	50×80	100		
	21			120		
3	6			100		
	14			100		
	21			150		
4	6			60		
	14	拡座	2(50×80)			

給桑量表（２齢期：対１万頭当り）

日	給桑時間	作　業	飼育面積	標準給桑量	実際の給桑量	備　考
			(cm)	(g)		
1	9		2(50×80)	200		
	14	桑付け		300		
	21			600		
2	6			600		
	14	網入れ		600		
	21			800		
3	6			600		
	14	掃き立て＆拡座	4(50×80)	300		
4						

給桑量表（３齢期：対１万頭当り）

日	給桑時間	作　業	飼育面積	標準給桑量	実際の給桑量	備　考
			(cm)	(g)		
1	9	桑付け	4(50×80)	600		
	14	網入れ		800		
	21			1,000		
2	6			1,000		
	14	掃き立て		1,000		
	21			1,200		
3	6			1,200		
	14	網入れ		1,200		
	21			1,200		
4	6	掃き立て＆拡座				
	14	(1.2×2.2m)		1,000		
	21	(壮蚕飼育室へ移動)				

給桑量表（４齢期：対１万頭当り）

日	給桑時間	作　業	飼育面積	標準給桑量	実際の給桑量	備　考
			(m^2)	(kg)		
1	9	桑付け	2.6(1.2×2.2m)	3		
	14	網入れ		4		
	21			8		
2	6			10		
	14	掃き立て	4.0(1.2×3.4m)	10		
	21			12		
3	6			12		
	14			12		
	21			12		
4	6			4		
	14					
	21					

給桑量表（５齢期：対１万頭当り）

日	給桑時間	作　業	飼育面積 (㎡)	標準給桑量 (kg)	実際の給桑量	備　考
1	9 14 21	桑付け＆網入れ	6.5(1.5×4.3m)	15		
2	6 14 21	掃き立て	8.2(1.5×5.5m)	15 15 20		
3	6 14 21			20 20 30		
4	6 14 21			25 25 40		
5	6 14 21			25 25 40		
6	6 14 21			25 20 30		
7	6			20		

SILKWORM SEED TECHNOLOGY LABORATORY
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MANUAL ON MANAGEMENT OF LOOSE EGGS PRODUCTION IN SILKWORM

Commercially, silkworm eggs are produced either on paper or as loose grains whereas reproductive eggs are generally prepared on paper cards. The concept of loose egg production and distribution is well practiced in countries like Japan and China, wherein industrial eggs are produced as loose eggs and are extensively popular. But in India, this concept has not yet percolated to the desired magnitude and is yet to be accepted. Thus it becomes essential to examine the reasons for the unpopularity of loose egg production, its distribution and the remedies to be addressed to introduce them successfully.

Experiences have shown that the reasons for non-acceptance or reluctance from both the egg producers and farmers, is basically due to lack of technical know-how and inadequate infrastructural facilities from the egg producer's side; and the difficulties encountered by the farmers while brushing. Hence, these two crucial aspects demand for development of an appropriate technology to plug these bottlenecks and to make the producer's and consumer's job easy towards loose eggs production.

Comprehending this task, Silkworm Seed Technology Laboratory, Bangalore has successfully solved these twin issues, through designing of suitable equipments and developing a package of know-how for producing the eggs in loose form under Bivoltine Sericulture Technology Development Project sponsored by Japan International Co-operation Agency.

This document is intended to serve as a practical guide to the graineures for the production of loose eggs scientifically and systematically.

Production and distribution of loose eggs have certain advantages both qualitatively and quantitatively, which are highlighted below.

ADVANTAGES OF LOOSE EGG PRODUCTION:

1. Loose eggs are supplied in standard unit by weight by maintaining the egg number uniformly irrespective of the race and season. A unit number of 20,000 eggs are packed in each loose egg case which is equivalent to 50 layings on paper-card.
2. Since there is uniformity in egg number, the evaluation of inter-racial and seasonal performance of breeds is more accurate and scientific.
3. It serves to eliminate most of the defective eggs and supply only good eggs so that fertile egg ratio is maintained and ensures good hatchability.
4. In bivoltines, even the unfertilized eggs could be isolated when cold acid treatment or hibernation is resorted to.
5. The egg recovery in grainages could be substantially increased as the healthy layings with low fecundity are also collected.
6. Surface disinfection of eggs could be efficiently accomplished.
7. Space required for handling of moths during egg laying, is comparatively less.
8. Preservation, incubation and transportation of eggs is extremely easy and convenient.

Owing to the above advantages, it becomes imperative to popularize loose egg production and distribution in the field. However, for an extensive popularization and successful introduction, it is indispensable not only to provide the right type of infrastructural facilities but also to train the egg producers in production technology and extension workers and farmers in brushing procedures.

EQUIPMENT FOR LOOSE EGG PRODUCTION:

For loose egg production, additional and specific equipments are required. The list of equipments and the purpose for which they are required is provided in table below:-

EQUIPMENTS REQUIRED FOR LOOSE EGG PREPARATION

Name of the equipment/material	Purpose
1. Starched craft paper sheets/ Lawn cloth	For oviposition
2. Starch (Arrow root powder/maida),	For smearing on the sheets
3. Oviposition trays	For oviposition
4. Oviposition stands	For oviposition
5. Egg washing tray	For washing and collection of eggs.
6. Nylon mesh bags	For collection of eggs
7. Acid treatment equipment (perforated acid treatment container/nylon bags)	For acid treatment
8. Egg drying unit	For drying of eggs
9. Washing Machine/Spin drying machine	For drying of eggs
10. Defective egg separator	For eliminating defective eggs
11. Loose egg preservation trays	For egg preservation.
12. Winnowing unit	To eliminate dead/bad eggs
13. Electronic top loading balance	For weighment of loose eggs.
14. Adhesive covers/Loose egg boxes	For packing and incubation.

LOOSE EGG PRODUCTION PROCESSES

Following are the various steps and techniques involved in loose egg production:

I : Preparation of starched egg sheets :

It is a physiologically based instinct, that the silk moth, while ovipositing the eggs, coats the undersurface of the eggs with a characteristic gluey substance. This enables adherence of eggs to the substratum, the egg card/sheet. These eggs are rather fixed and would not dislodge easily. The ideology exploited for loosening of eggs is precisely simple. The moths are allowed to lay eggs on the artificially starched sheets and when these sheets are immersed in water, apparently the gum dissolves and the eggs get dislodged when rubbed gently.

The egg sheet can be smeared with any commercially available starch material. Of the various commercially marketed starches, maida and arrow root powder are widely used and are freely available. However, for comfortable application and easy handling, arrow root powder stands an edge over maida.

i) Preparation of gum :

About 40 to 50 g of starch is required to prepare one litre of paste. For preparing the paste, starch is weighed first and dissolved in little quantity of water and kept seperately. The rest of water is heated up and when the water is boiling, the prepared solution is added up,stirred well and boiled till it forms a paste. To prevent any mould attack on the starched sheets, 10-15g of boric acid is added to the above mixture, while heating. The paste is smeared on to the egg sheet so as to create a thin film over it. A foam strip is more apt for the purpose of application as it gives a thin and uniform spread of gum over the surface. Care should be taken while smearing so as

to cover the entire surface area of the sheet without leaving any gaps. Too dense an application of the starch or inadequate smearing renders loose egg preparation difficult. Consequent to this application, the sheets are dried under shade. One litre of paste is sufficient to smear, about 20 m^2 surface area of sheets. Speculating on the magnitude of proudction for the month/season,the required quantum of sheets is prepared well in advance and preserved in dry conditions.

A thick craft paper should be selected for preparing the starched sheets so that they could be repeatedly used and make loose egg production more economical. Alternatively a lawn cloth could also be used for the purpose.

ii) Size of the egg sheet :

The size of the egg sheet varies according to the oviposition tray as oviposition is allowed in trays. The egg sheet size should measure to extend along the height of the frame on all the four sides of the tray, as the moths have a tendency to crawl on to the sides. Egg sheet of 105cmx75cm is more ideal to befit a 90cmx60cm oviposition tray. However, it is suggested that the size of the tray or egg sheet can be tailored according to the convenience of a graineur.

II OVIPOSITION :

The pairing of male and female moths is done in separate trays. After 3 to 4 hours of pairing, the moths are decoupled, stimulated for urination by tapping the tray and transferred into the tray spread with the starched sheet. The starched sheet is spread in such a way that it is extended to all the four sides of the frame as the moths sometime tend to move on to the sides and deposit eggs.

i. Density of moths for oviposition :

In case of sheet egg preparation, each mother moth is enclosed in a cellule for oviposition and for the sheet measuring 29cmx22cm (which is most commonly used in India), 20 moths are placed. In case of loose egg preparation covering of moths with cellules is not necessary (Fig 1). Hence for an approximate of 0.54 sq. meter base area, an optimum number of about 250 of bivoltine or 275-300 of multivoltine moths can be distributed. To ensure uniform distribution and prevent overcrowding, the optimum number of moths to be distributed per each egg sheet is determined and weighed initially. For example, if 250 moths are to be distributed over a (105x75 cm sheet which gives a net 90x60cm base area) 0.54 sq. mt. base area, they are weighed first and if the moths weigh 300 g, on every occasion 300 g are weighed and distributed over the sheet. Subsequently for every sheet, the moths are weighed and broadcasted over the sheet.

ii) Oviposition trays :

Wooden trays with plywood bottom measuring 90x60cm with 5cm height are suitable. However, trays fabricated exclusively with an arrangement to confine the moths to the tray could be used (Fig. 2). The restriction of the moths is achieved by affixing a GI/steel sheet flap of 4 cm width along the length of the tray on both the sides. The flap is rivetted in such a way that it could be released to the exterior so as to sit parallelly with the frame along the length of the tray, while depositing the moths and tilted to the interior after the moths are distributed. With this arrangement the moths remain inside the tray and do not escape.

The starched sheets are spread inside the oviposition trays and extended to the height of the tray on all the sides to prevent the moths laying the eggs on the wooden frame. The female

moths are deposited over the egg sheet and the flap is released so as to rest on the tray. Later the oviposition trays are stacked in the oviposition stand.

iii. Oviposition

The entire room is made totally dark and oviposition is allowed for 1 to 2 days depending on the need. It is essential that optimum temperature of 25°C and RH of 75-80% are maintained for effective egg laying by the moths. The silkworm eggs programmed for common acid treatment or chilling, where age of the eggs plays a decisive role, eggs laid during a definite duration could be collected in batches and treated accordingly.

III. HANDLING OF LOOSE EGG SHEETS

If the bivoltine eggs are to be hibernated for long term preservation or chilled for shorter duration, it is preferable to preserve the sheets without loosening the eggs. The egg sheets are suspended individually over steel rods fixed across each shelf of the stand. The loose egg sheet preservation stand (Fig. 3) is fabricated to a height of 155cm, 140cm width and 80cm breadth, with three partitions and mounted on heavy duty castors. On the first two partitions, 1cm dia steel rods are fixed across the breadth with 2cm gap all along the width of the partition. In the third lower most partition cloth is tied for the collection of eggs which fall incidentally. The sheets are hung in two tiers. After the accomplishment of hibernation schedules, the sheets are released, washed, defective eggs separated and packed in loose egg cases. In this practice, space requirement is greater and space is a constraint, the eggs are loosened after ovipositon and preserved for hibernation.

Similarly, multivoltine and bivoltine eggs to be acid treated, are loosened and processed.

IV. COLLECTION OF LOOSE EGGS

For pebrine inspection, the required number of moths are collected, after egg laying, depending on the sample size for moth examination. After confirmation of disease freeness, the egg sheets are collected and immersed in water basins (Fig. 5A) for about 15 minutes, so as to dissolve the artificially smeared starch. Loosening, washing and drying process are same for all the types of eggs.

Loose egg collection unit

To facilitate comfortable and swift dislodging and collection of eggs, a specially fabricated tray egg washing placed on a stand is used (Fig. 4).

The tray is elongated and pentangular in shape measuring about 133cm length x 90cm width and the sides converging towards the centre point so as to give a pentangular shape. At the terminal an exit point is provided through a 4cm dia pipe, for the collection of dislodged eggs. The tray should be shallow with 5cm depth and could be fabricated out of any rust-proof metallic sheets such as steel or aluminium or GI and is rested on a wooden stand which is structured at an inclined angle for operational convenience. Thus, the tray attains a slopy position which accelerates the movement of eggs in a downward fashion and facilitates easy collection. On the elevated side of the tray along its width, a 4cm dia meter PVC pipe with small pores is arranged and is connected to a water source. The pores of 0.2cm size drilled at a distance 0.5cm on the PVC pipe. However, to further improve the efficiency and expedite collection, an additional hose pipe is also arranged which is held in the left hand while removing the eggs. Release of water simultaneously from both the pipes enables easy removal,

prevents sticking of eggs to hand and rapid collection through the terminal point.

The stand which houses the tray should be a sturdy one and is fabricated in wood or steel. The top frame of the wooden stand on which the tray sits is precisely fabricated. For easy operation, the stand is prepared to reach an height of 88cm at the elevated point and 77cm at the inclined point (Fig. 4).

Commensurate to the magnitude of production, two or three of such assemblies are arranged in a row in the egg processing room.

For collection of eggs, a nylon mesh bag is tied at the terminal point of the tray. The mesh size or the perforations should be smaller than that of the eggs.

Then each egg sheet is taken from the basin, placed on the tray and water is allowed to flow from both the pipes (Fig. 5B and 5C). And with a gentle gliding movement by hand the eggs are removed. The detached eggs stream down towards the terminal point and slip into the bag, while water is instantly drained out.

V. DEGUMMING OF EGGS

During the dislodging process, the gum from the egg sheet gets partially released and incidentally coats the egg surface, though in a microlayer. This gum has to be essentially removed, lest it would lead to the formation of clumps and interferes in the process of drying.

For the purpose of degumming, the loose grains are released into 0.2 to 0.3% of freshly prepared bleaching powder solution and washed for 10 minutes. Concentration exceeding 0.5% is extremely lethal as bleaching powder has ovicidal effect, sometimes causing instant mortality. The treatment not only

helps in making the grains free but also serves as a surface disinfectant to the eggs. After the treatment, the eggs are thoroughly washed in water to eliminate, the traces of the chemical, if any. The eggs are then collected into nylon mesh bags and spin dried. Water temperature should not be below 15°C or above 30°C while washing and collection of eggs.

Bleaching powder treatment is adopted only for multivoltine eggs and the bivoltine eggs preserved for regular hibernation schedules (4,6 and 10 months). The treatment is not required for bivoltine eggs designated for acid treatment (both artificial hatching and acid treatment followed by chilling) as hydrochloric acid, itself acts as a degumming agent.

Preparation of bleaching powder solution :

The commercial bleaching powder contains about 25 to 35% chlorine and that is to say that 100 g of bleaching powder contains 25 to 35% chlorine. For the purpose of degumming bleaching powder with above 30% chlorine content is used. For preparing 0.3% bleaching powder solution, 30 g is dissolved in one litre of water. Since the powder does not dissolve readily, it is collected in nylon mesh bag and squeezed in water to get the required concentration of bleaching powder solution.

VI DRYING OF EGGS :

The eggs collected in the bags are gently squeezed to drive out the moisture or passed through a spin drying unit of domestic washing machine. While spin drying, the eggs are placed in the spinning unit and the machine is switched on just for a moment and switched off immediately. Later the bags are retrieved and eggs dried under gentle breeze using egg drying units.

Egg drying unit

This unit is a rectangular box type chamber made of wood with fans fixed at the bottom so as to blow air upwards. The top surface is affixed with steel mesh (one cm) or a bamboo mat and over which a nylon cloth is spread (Fig. 6).

For accomplishing the drying of eggs, they are released and spread onto the platform over the nylon cloth and the fans are switched on so that the wind directly reaches the eggs and drying completed at a rapid pace. The eggs are gently mixed two or three times and spread for easing the drying process. This would not only hasten the drying process but prevents formation of clumps.

After adequate drying, which would result as free loose grains, the multivoltine hybrid eggs or the hibernated eggs after the termination of diapause (completion of hibernation schedules) are subjected to winnowing. However, the bivoltine eggs identified for artificial acid treatment (Hot acid treatment with 1.075 Hcl - 46.1°C temperature or 5 or 6 minutes soaking or cold acid treatment with 1.10 sp.gr. Hcl - 25°C temperture and 60 to 90 minutes of soaking or the ones chilled for shorter durations (35 to 70 days) required to be acid treated (Hcl with 1.10 sp.gr. - 47.8°C temperature and 5 to 6 minutes dipping) are collected and treated as described below.

VII. ACID TREATMENT OF BIVOLTINE EGGS

Eggs after drying are gathered into a specially designed perforated plastic container or a double layered nylon mesh bag where acid exchange is carried out with ease. The container should be filled only one-third of its volume to enable free movement of eggs and ensure uniform exposure to acid. However, it is advised to treat only 1 to 2 kgs of eggs at a time.

In case hot acid treatment is resorted to, the plastic container (Fig. 7A), after dipping in the acid, is rotated slowly in clockwise and anticlockwise manner to facilitate movement of the eggs and uniform exposure to acid. If a nylon cloth bag is used, the eggs are slowly disturbed with hand or a glass rod (Fig. 7B). After the specified duration of soaking, the container/bag is taken out, acid drained for a few seconds and washed in running water for 30 minutes till no acid traces are felt (Fig. 7C). The drying process is accomplished in the same manner as described earlier.

VIII. WINNOWING OF EGGS :

Prior to packing, the loose eggs of all types are winnowed to isolate the lighter/flattened/dead/unfertilized eggs. The winnowing arrangement comprises of a big funnel like feeder (28x30x28cm) fixed on a table/stand (Fig. 8). A fan is firmly fixed on to a stand horizantally and is placed one foot below the table and the distance is adjusted in such a way that only the lighter eggs are blown away. The loose grains are fed from the top and the fan is switched on. Because of differential weights, the eggs which are lighter in nature, due to wind force are drifted away and collect at a distance. The heavier eggs collect into a heap which are later divered for packing.

IX. ELIMINATION OF UNDESIRABLE EGGS

Removal of unfertilized and dead eggs

Even though there is a recommendation from temperate countries about the possibility of separation of unfertilized eggs using saline solutions, it is practically not possible to achieve this, in hot acid treated eggs or in multivoltine eggs for the following reasons.

1. In general, the average specific gravity of the eggs is around 1.07 to 1.08, though they vary from 1.06 to 1.09.

It is known that there is no variation between the specific gravity of fertilized and unfertilized eggs upto 4 to 5 days after oviposition. Hence, separation of unfertilized eggs by exploiting difference in specific gravity cannot be achieved soon after laying.

2. Even though there is slight variation in the specific gravity after 5th/6th day between the fertilized and unfertilised eggs, the variation is not so distinct for clear separation. During this process, we are bound to loose some of the good eggs along with the unfertilized ones as they are mixed together.

3. With the advancement in the embryonic growth, the fertilized eggs lose significant weight and become lighter while their unfertilized counterparts do not lose such weight. Such distinct difference is noticed only during pin-head/blue egg stage. However, owing to the detrimental effect of saline on the embryo, it is not advisable to use this process for separation. In addition, since the eggs are in the penultimate stage of hatching, handling and distribution of the entire quantity of eggs become practically difficult.

4. It is also found that in case of bivoltine, when the eggs are subjected for hot acid treatment, for artificial hatching, there was no effect of the acid on the unfertilized egg and hence cannot be separated.

5. Another difficulty that is encountered is the variation of egg weight among the fertilized eggs. The early laid eggs are generally heavier while the eggs laid at the end are lighter. Added to this, the weight of eggs differ from moth to moth. So the difference in weights in initial days is difficult to be exploited for separation.

However, it is possible to eliminate the unfertilized eggs in cold acid treated and hibernated eggs. In case of cold acid treatment, the unfertilized eggs get crumbled, due to long exposure to acid and it is possible to separate majority of the unfertilized eggs. The separation of unfertilized eggs is achieved in toto in hibernated layings. This is due to the fact that unfertilized eggs get desiccated owing to prolonged exposure to low temperature and can be eliminated successfully either by winnowing or in saline medium.

From the preceding it can be summed up that separation of unfertilized from fertilized eggs is not possible in multivoltine and hot acid treated bivoltine eggs. The unfertilized eggs could be separated only in cold acid treated bivoltine eggs and bivoltine eggs preserved for hibernation schedules in water or by winnowing.

X. PACKING STANDARDS

The weight of silkworm egg varies from race to race, season to season and even from crop to crop. A unit of 20000 eggs equivalent to 50 Dfls at the rate of 400 eggs/laying, is considered as a standard unit. To achieve the standard number, one gram of eggs is weighed on an electronic balance and the number is counted accurately. Accordingly, the weight is computed as follows :

Say no. of eggs per gram count 2000

Thus, the weight for 20,000 eggs is 20000/2000 = 10g. The requisite amount is weighed and packed into loose egg cases. Bivoltine eggs generally weigh between 1500-1700 and the multivoltine eggs 1800-2100 per gram. Instead of weighing every time after determining the weight for 20,000 eggs, the weighed eggs can be filled in a narrow test tube and the level can be marked with a glass marking pencil. The same volume may be used

for subsequent measurement and packing of the eggs. Since weight loss is observed with everyday's development, the counting and packing should be done simultaneously on the day of packing.

Packing of eggs is conducted in two ways.

A. Use of adhesive covers: An adhesive egg cover for packing of loose eggs is designed at SSTL. This cover consists of a thick black paper of size 30cm x 21cm (LxB), on which suitable gum strips of 3cm width and 28cm in length are laid longitudinally (Fig. 9A). There are five such gum strips towards the longitudinal side. The distance from one gum strip to the other is 1cm. Thus, 420 sq. cm. gummy space is available for sticking approximately 20000 eggs (50 DFLs). On the gum strips, round thermocole nodule beads of size of 2 to 3mm diameter have been fixed to avoid sticking of the covering sheet or tissue paper (Fig. 9B). A tissue paper is then fixed as cover over the black paper from all the border sides. At one corner of this tissue paper, a hole of 2cm diameter has been made to pour the eggs in the cover. Eggs are poured into the cover with the help of a funnel (Fig. 9C). The tissue cover is sealed lightly so that it could be removed easily to enable observation of the development of eggs. This paper can be removed and refixed two to three times after observation of development.

After pouring the eggs inside the cover, it is tilted in such a way that the loose eggs inside the cover are uniformly distributed and stick to the gum. Later 2-3g of RKO is slipped into the cover and shaken. This powder settles on empty gummy surfaces and stops the larvae sticking to the gum after hatching.

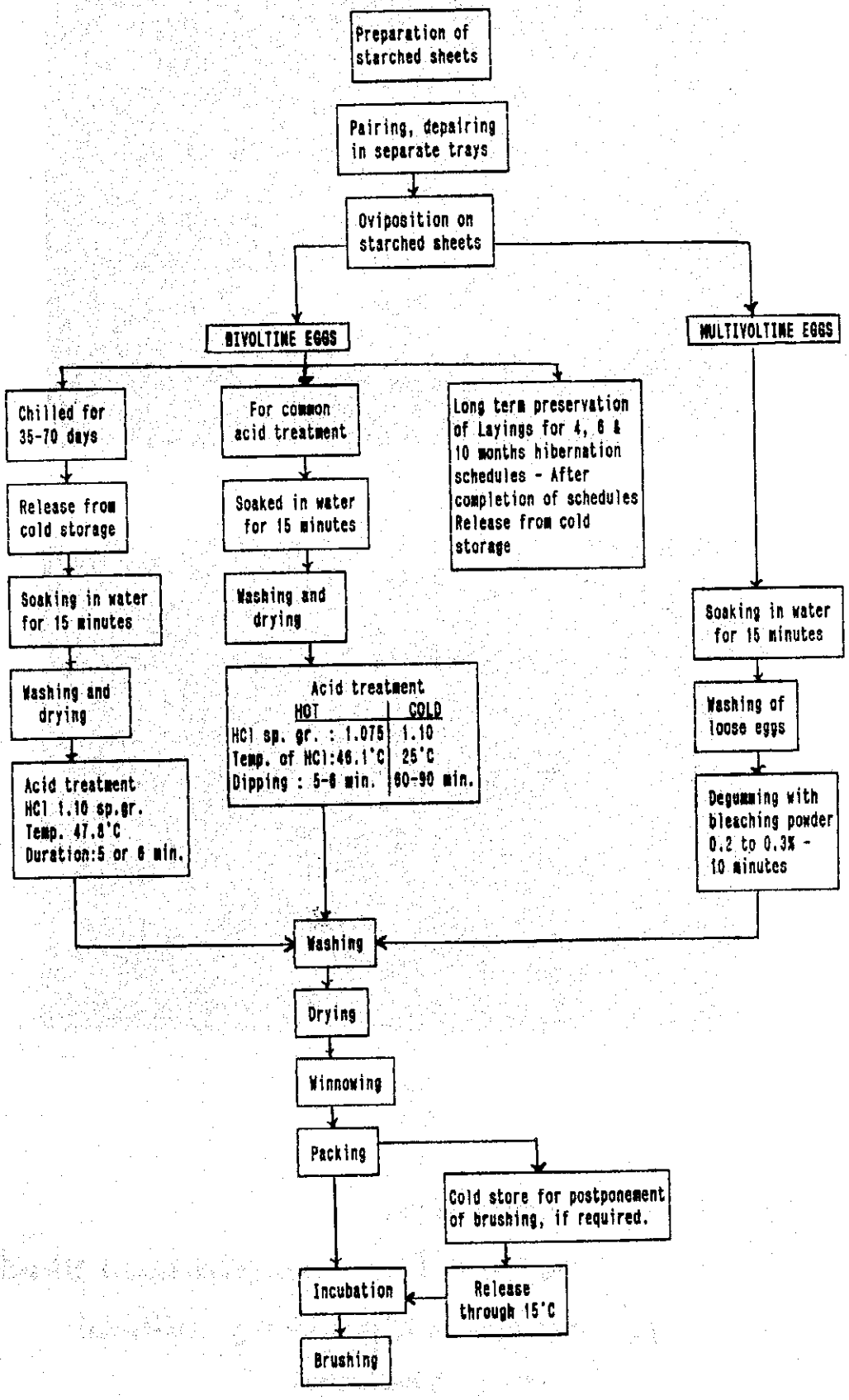
During brushing the top cover is removed and the adhesive sheet serves as the regular egg card. This cover is more handy and convenient and the farmer encounters no difficulty as it is nothing but transformed egg card.

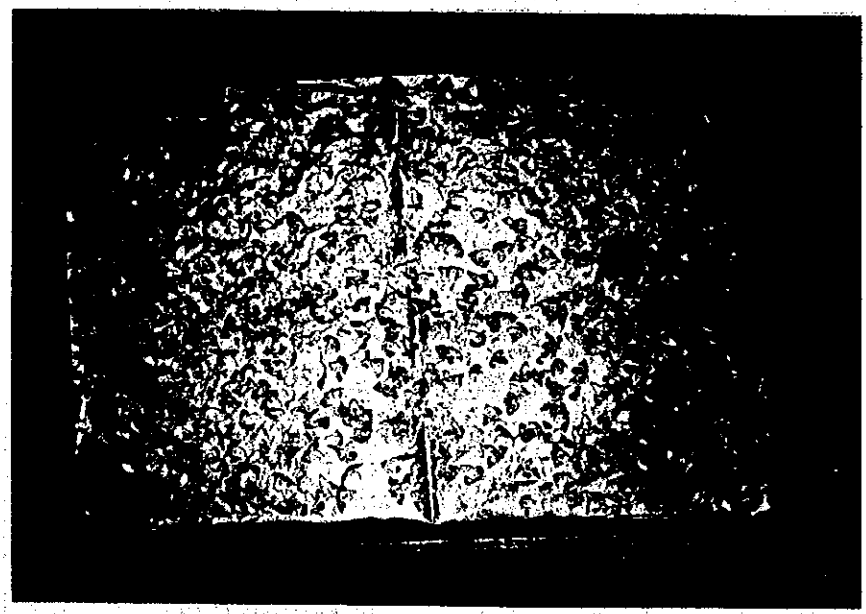
B. Use of loose egg boxes: A simple wooden frame lined with muslin cloth is generally used for packing loose eggs. The cloth enables circulation of air and provision of light. Through a slit located on the right hand corner of the frame, a funnel is inserted through which the eggs are slipped (Fig. 10A). Subsequently the opening is sealed with a sticker and an inxed slip affixed on the frame (Fig 10 B).

For the purpose of brushing, when the eggs attain the pin head stage, the loose eggs are extracted from the box and spread in a tissue paper. Black boxing is carried out by following the development. On the day of hatching, at the time of exposure to light two mosquito net pieces are spread over the loose eggs. For the purpose of brushing leaf is sprinkled over the net and the larvae crawl onto the net. The first net is lifted and placed into the rearing tray. The second net facilitates separation of hatched egg shells and the unhatched eggs.

oOo

FLOW CHART FOR LOOSE EGG PREPARATION





A

B

Fig 1 Oviposition

A. Oviposition on starched sheets

B. Moths ovipositing without any enclosure

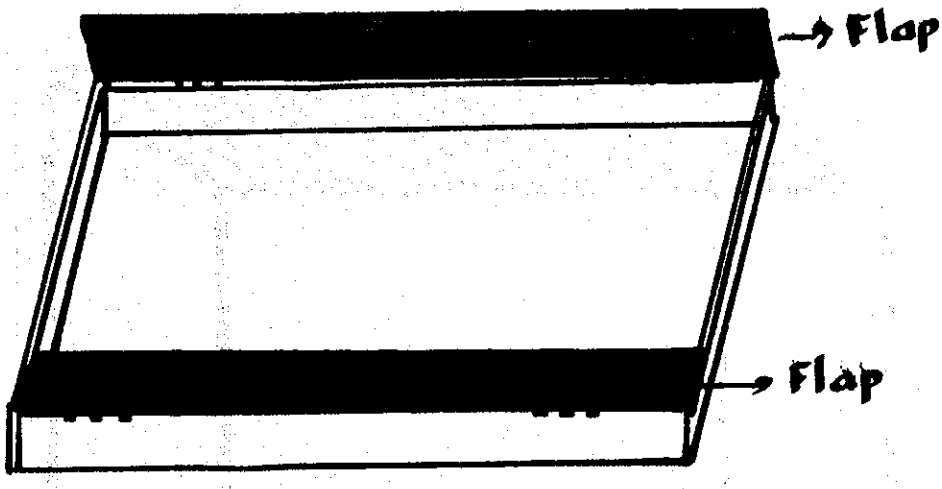


Fig 2. Oviposition tray with flaps

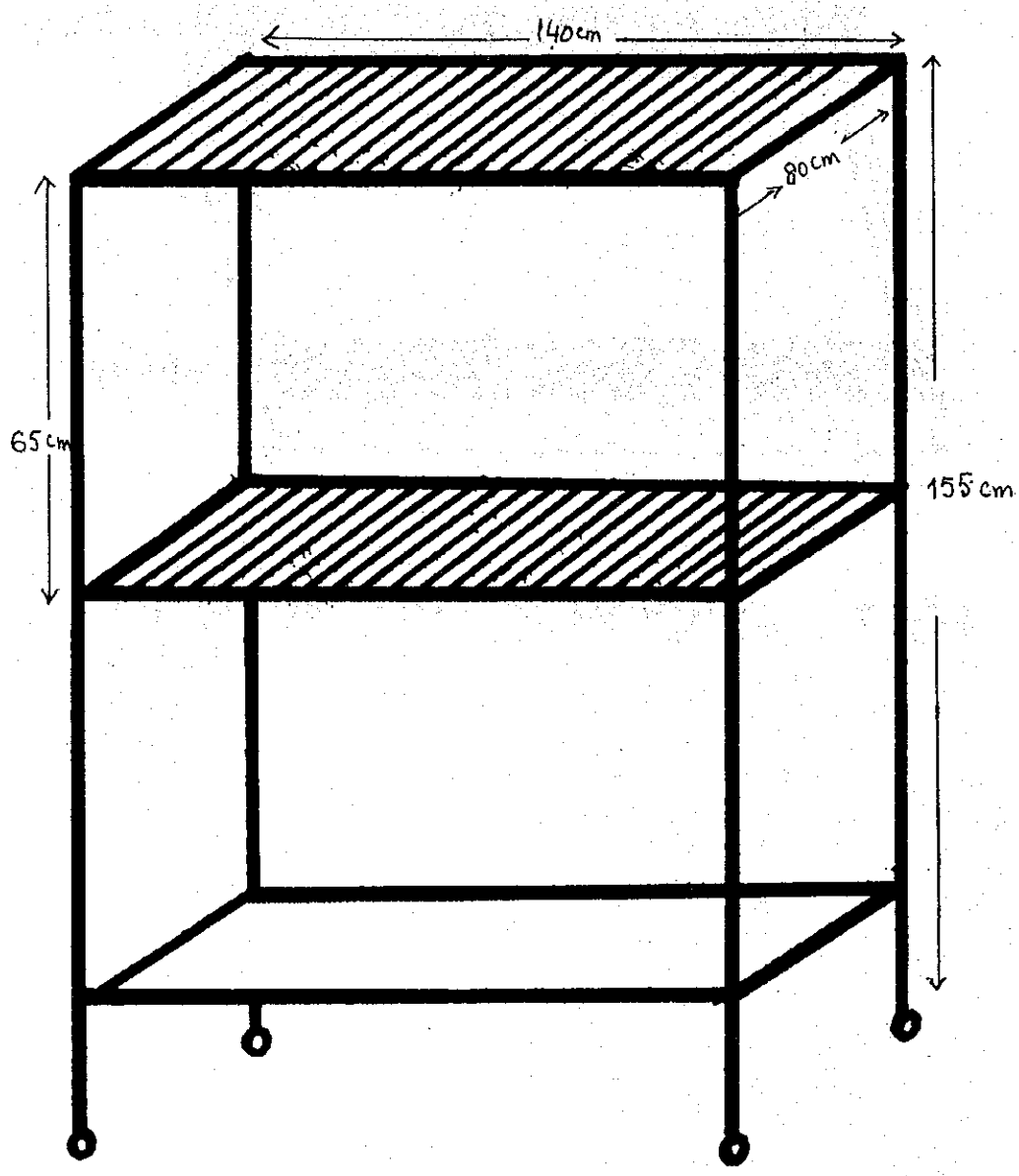


Fig 3. Loose egg sheet preservation stand

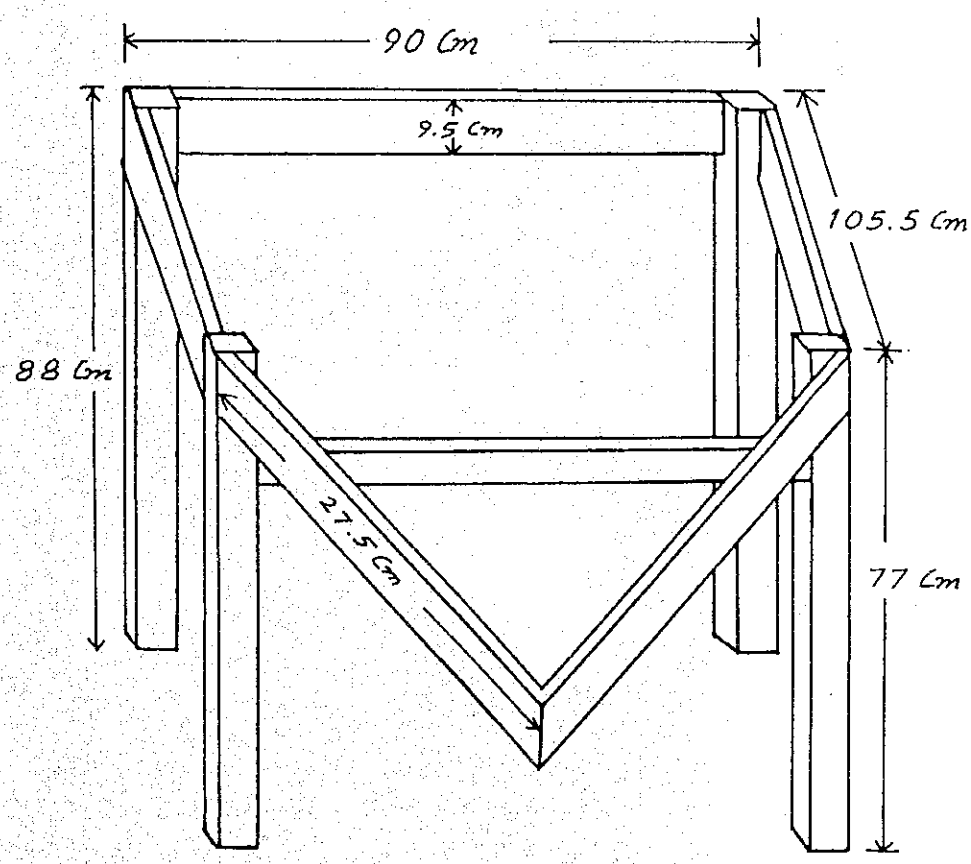


Fig. 4 EGG WASHING TRAY

Fig 5A

Fig 5B

Fig 5C

Fig 5. Collection of loose eggs
A. Soaking of eggs in water
B. & C. Gentle rubbing and collection of eggs

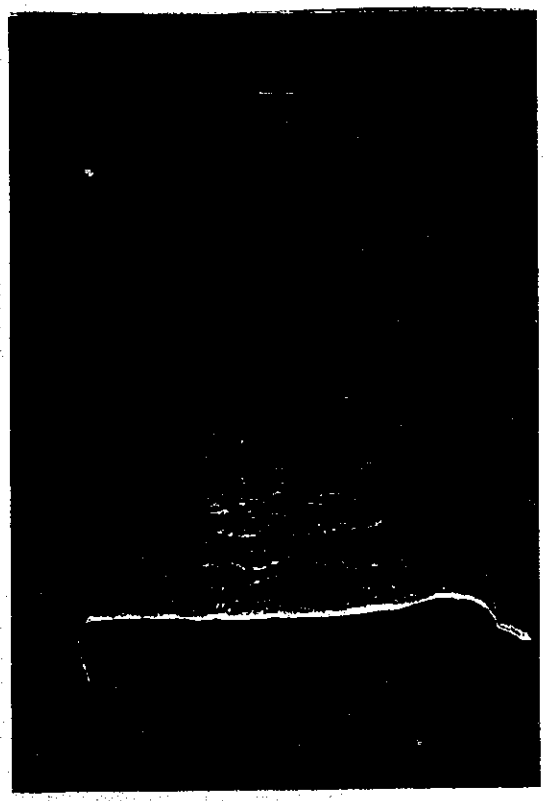
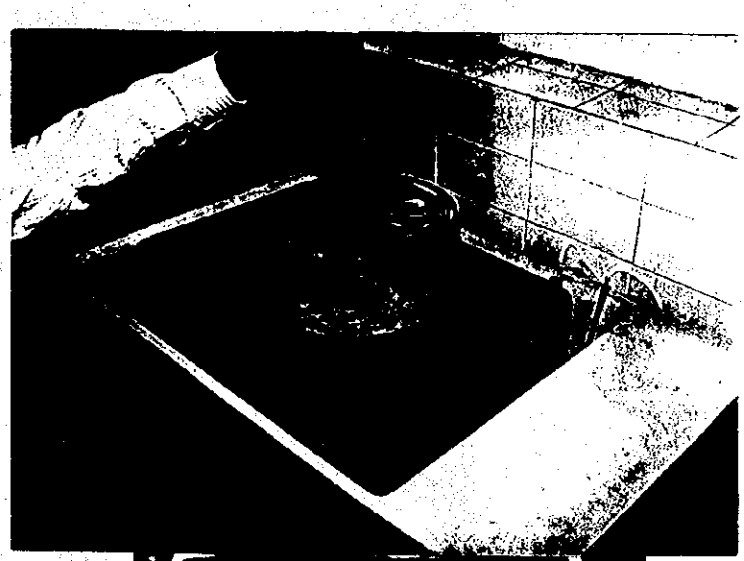


Fig 6 Drying of eggs

Fig 7. Acid Treatment of Loose eggs

7.A
Acid Treatment using perforated plastic container



7.B.
Acid Treatment using nylon bags

7.C
Washing of eggs in running water after treatment.

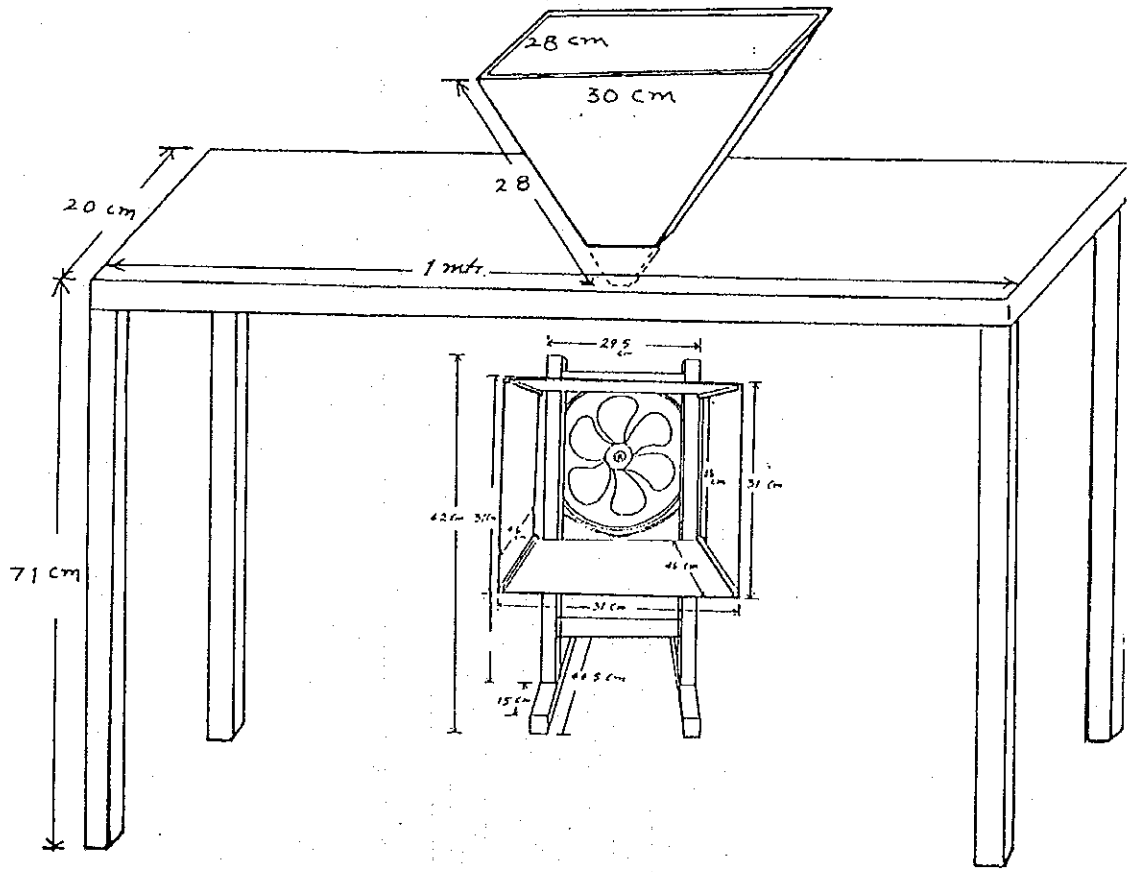


Fig 8. Winnowing Arrangement

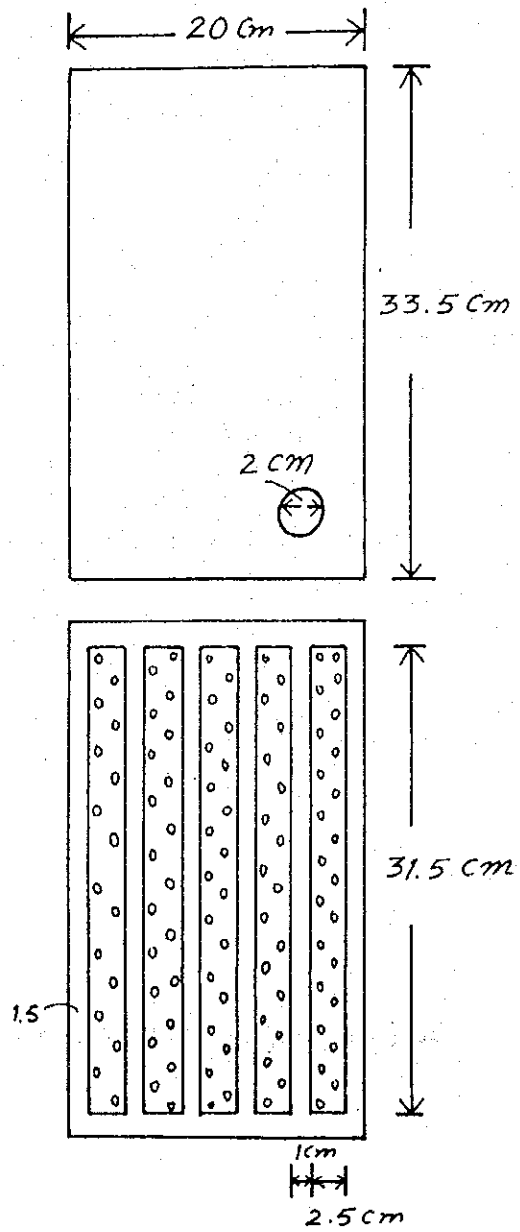


Fig 9 A. ADHESIVE COVER

Fig 9 B

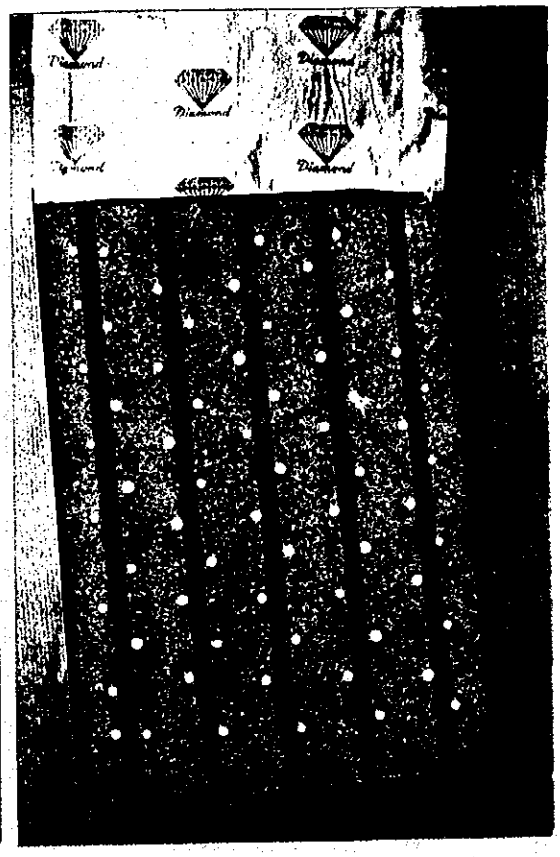


Fig 9 C

Fig 9 Packing of eggs in adhesive cover

9 B. Pouring of eggs

9 C. Inner view after packing

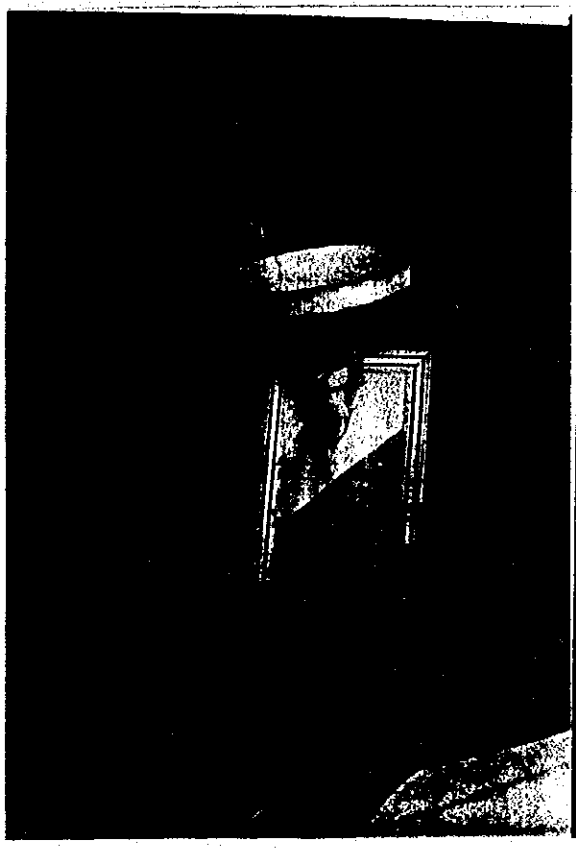


Fig 10A

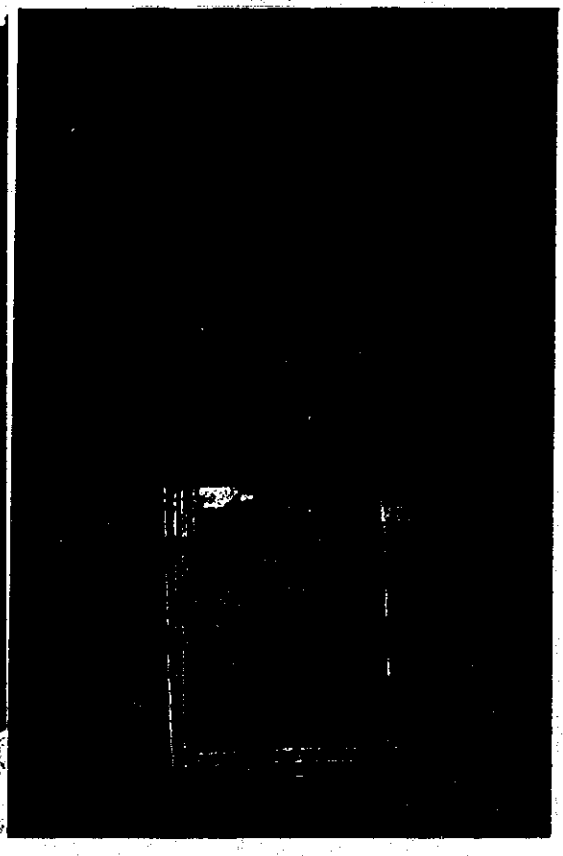


Fig 10B

Fig 10 : Packing of eggs in loose egg box

Fig 10A Pouring of eggs in box

Fig 10B Packed loose egg box with index slip

SILKWORM SEED TECHNOLOGY LABORATORY
KODATHI, BANGALORE-35

MOTH EXAMINATION TECHNIQUES

The production of high quality silkworm seed free from pebrine disease is essential for successful cocoon crops. Pebrine disease in silkworms is caused by the parasitic microsporidian *Nosema bombycis*, which is transmitted transovarially through the mother moths. The silkworms infected with pebrine do not succumb to death by toxin, but by deprivation of nutrient of the infected host. The disease could be controlled through the use of disease free eggs (mother moth examination) so far as the cocoon production is concerned. In the case of egg production, it is difficult to exclude the pebrine infection completely, because the spores are introduced into the rearing bed by wild insects infected with pebrine. Therefore, strict mother moth examination, effective disinfection and hygiene maintenance in silkworm egg production centres and rearing are important basic aspects for pebrine control.

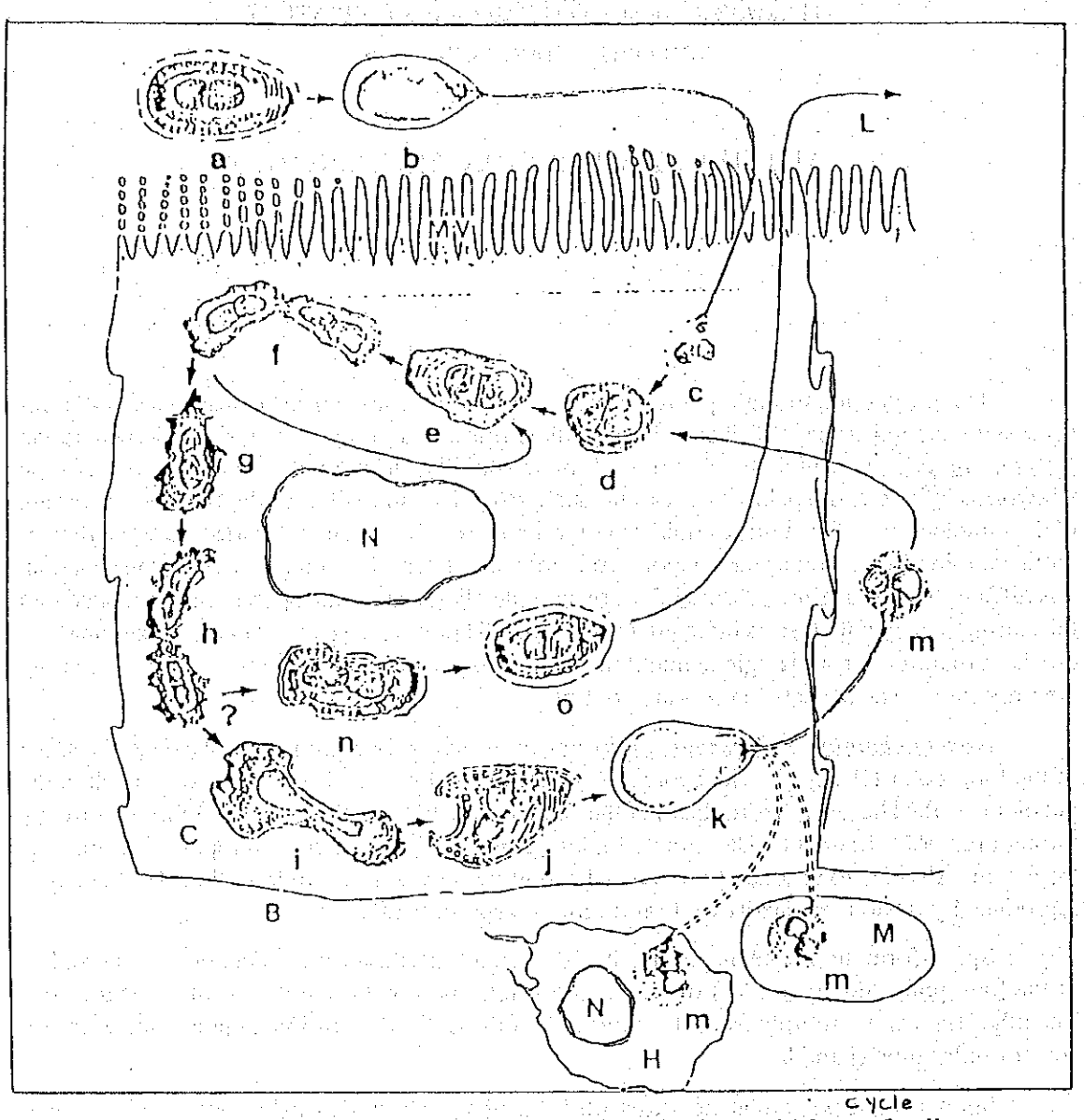
Nosema bombycis : *Nosema bombycis* can survive only within the host except the spore of the long polar tube type. The spores, when swallowed by silkworm larvae (a), hatch in the gut of host (b). The germ, sporoplasm of the spore is infected into the gut epithelium (C) directly through the polar filament. The infected germ grows in size to become a trophozoite (c). The trophozoite divides to produce schizonts (d and e) by binary or multiple fission (f). Schizonts reproduce by fission repeatedly (e, f) and turn into sporonts (g).

Spore formation is apansporoblastic, disporous and dimorphic. One type is sporoblast of the long polar tube type (LT) (n) turns into single spore with many coils of polar tube (o). The other type is the sporoblast of the short polar tube (ST) (i) turns into single spore with few coils of polar tube (j and k).

Spore of long polar tube measures 3.6 x 2.2 of oval shape with a thick shell. It is resistant form, may remain in an infected tissue or discharged by leaving host tissues infected. Spores of short polar tube will hatch directly in a host cell. Secondary sporoplasm (m) reaches other cells of host and infects. They can survive only in the cells of the host tissues.

Pebrine infection by transovarian transmission :

1. During the transovarian transmission the pathogen of pebrine disease passes through the egg to the next generation. In the rearing bed, the infected larvae drop faeces soiled with spores of protozoan along with infected tissues of gut.
2. Carriers of pebrine, hatched larvae from infected eggs, are the first source for the spread of disease within the silkworm larvae. Secondary infection occurs by the time of the second moult in the rearing bed.



Diagrammatic representation of the life cycle of Nosema bombycis in the silkworm, Bombyx mori larva

(H. Iwano & R. Ishihara, 1991)

a: ingested spore, b: hatching spore, c: sporoplasm, d and e: schizont, f: dividing schizont, g: sporont, h dividing sporont, i: sporoblast for ST, j: short polar tube type spore(ST), m: secondary sporoplasm from ST, n: sporoblast for LT, o: long polar tube type spore(LT), B: basement membrane, C: gut cell(only columnar cell is shown), H: haemocyte, L: lumen, M: muscle cell, MV microvilli, N: nuclear.

3. The larvae infected during the period of the first and second stage develop the disease from fourth to fifth stage and die before spinning. The infection may spread the disease and may induce the damage to the cocoon production.

4. They may also become the source for the second spread/ contamination. The larvae may spin a good cocoon and survive to the adult stage. But, they produce transovarially infected eggs. **The infection in the second spread of the disease may result in the damage to the seed production.**

In tropical country like India, the rearing of silkworms is practiced throughout the year because of the availability of mulberry and conditions are favourable. This enhances the possibility of secondary contamination from rearing rooms, implements and mulberry garden. Apart from this the condition of rearing house is not ideal to take up effective disinfection. Seed production is a continuous process, as a result the time available between batches in a grainage is too short to take up suitable precautionary measures or to conduct effective screening. Any attempt to control pebrine is not complete without an efficient mechanism to monitor the incidence of the disease regularly. Hence, monitoring of the disease has to be done at different levels.

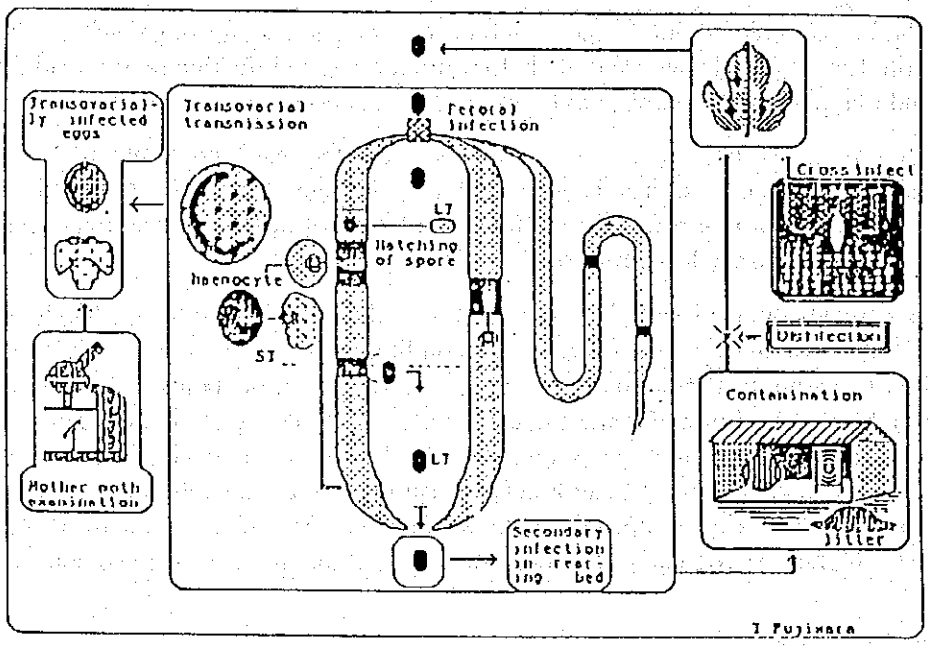
a) Cocoon markets
b) Silkworm Seed Production Centres
c) Seed crop monitoring
d) Private Seed Production Units.

The following procedure of examination is to be adopted to control and monitor the disease at the seed crop rearing, silkworm seed production centres and cocoon markets. This procedure has distinct advantages in that a unit number of moths or pupae or larvae or dust are crushed in a mechanical crusher, which ensures liberation and separation of pebrine spores from the host tissues and the homogenate following filtration is centrifuged to enable sedimentation of spores in a concentrated form. This enables easy identification and better examination method.

MOTH EXAMINATION

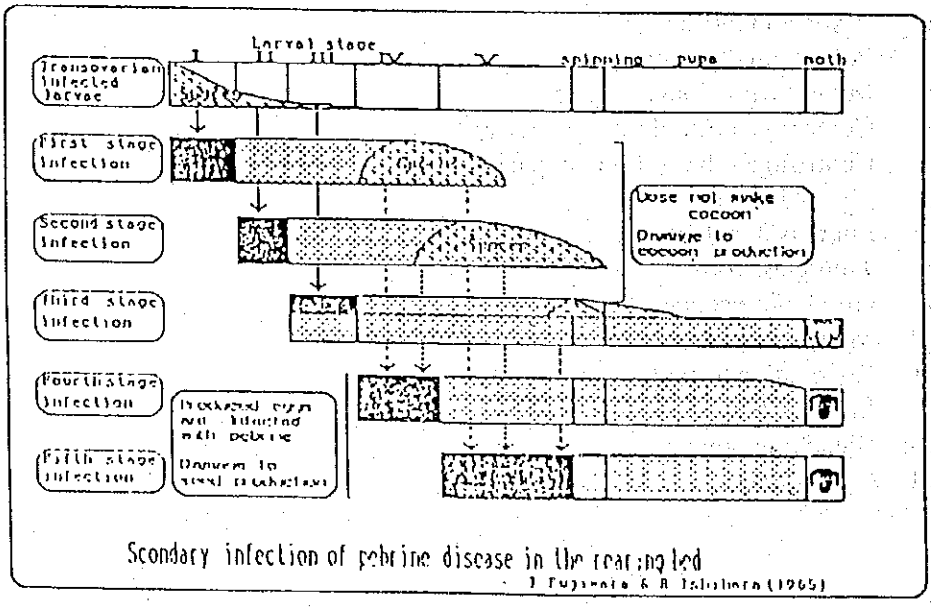
Requirements :

1. Pestle and mortar
2. Potassium Carbonate
3. Mixers with elongated jars
4. Centrifuge (100ml tube capacity)
5. Centrifuge tubes (100ml capacity)
6. Plastic beakers
7. Funnels 3 inch/10 cm diameter
8. Thin glass rods
9. Good microscopes
10. Microslides
11. Cover slips (round)
12. Muslin cloth
13. Bleaching powder
14. Cyclomixer

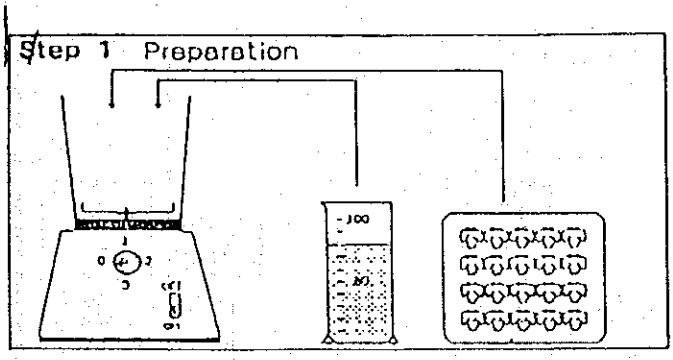


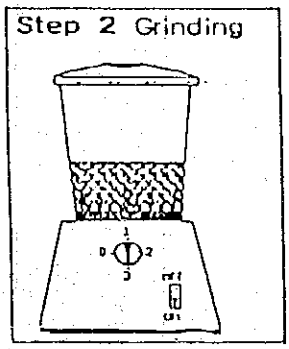
"The production of high quality seed which is absolutely free from Pebrine disease is essential for successful cocoon crops and flourishing sericulture industry.
(manual on silkworm egg production, p. 5)

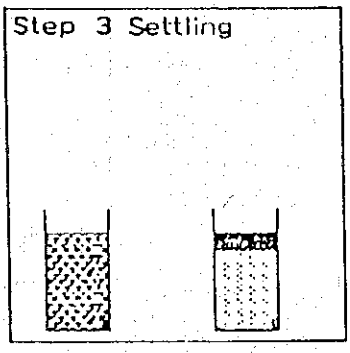
① Infection of pebrine disease take place transovarially and perorally.
② Nosema bombycis inhabits cell of all the tissues of the silkworm.
③ Faeces, cast skin of larva as well as carcases of pebrine infected larva can be sources of peroral infection. Some of the wild insects infected with Nosema may also form sources of pebrine infection.
④ Strict examination of mother moth and effective disinfection are basic method for the control of pebrine disease in sericultural industry.

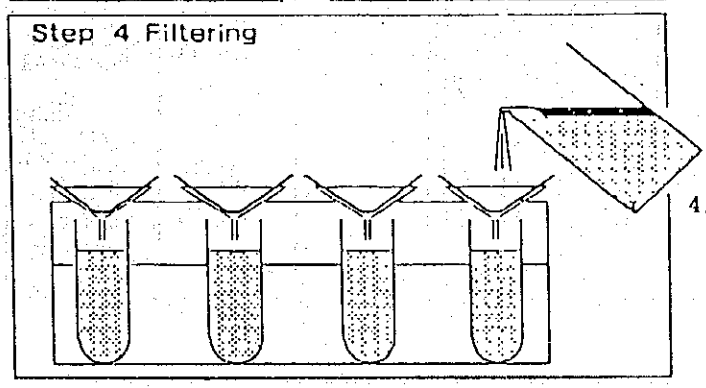


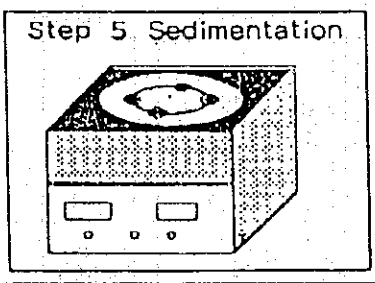
Scondary infection of pebrine disease in the rearing bed
T. Fujiwara & R. Ishihara (1965)

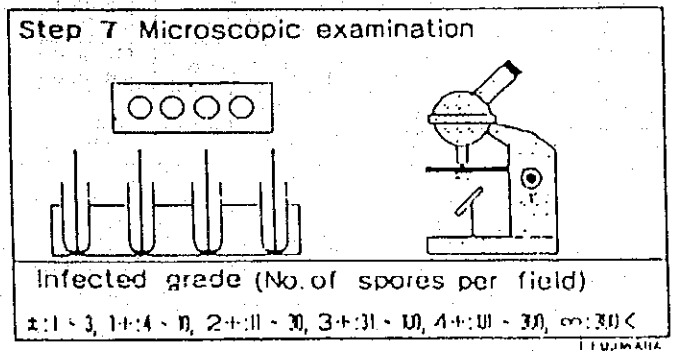












Mass Moth Eexamination

1. Preparation of materials
   Green moth : 20 moths

   Grinding solution
   0.5 ~0.6% K_2CO_3 solution
   volume of solution : 80ml

2. Grinding
   Homogenizing the infected tissues of host to take off spores by a mixer for one or two minutes.

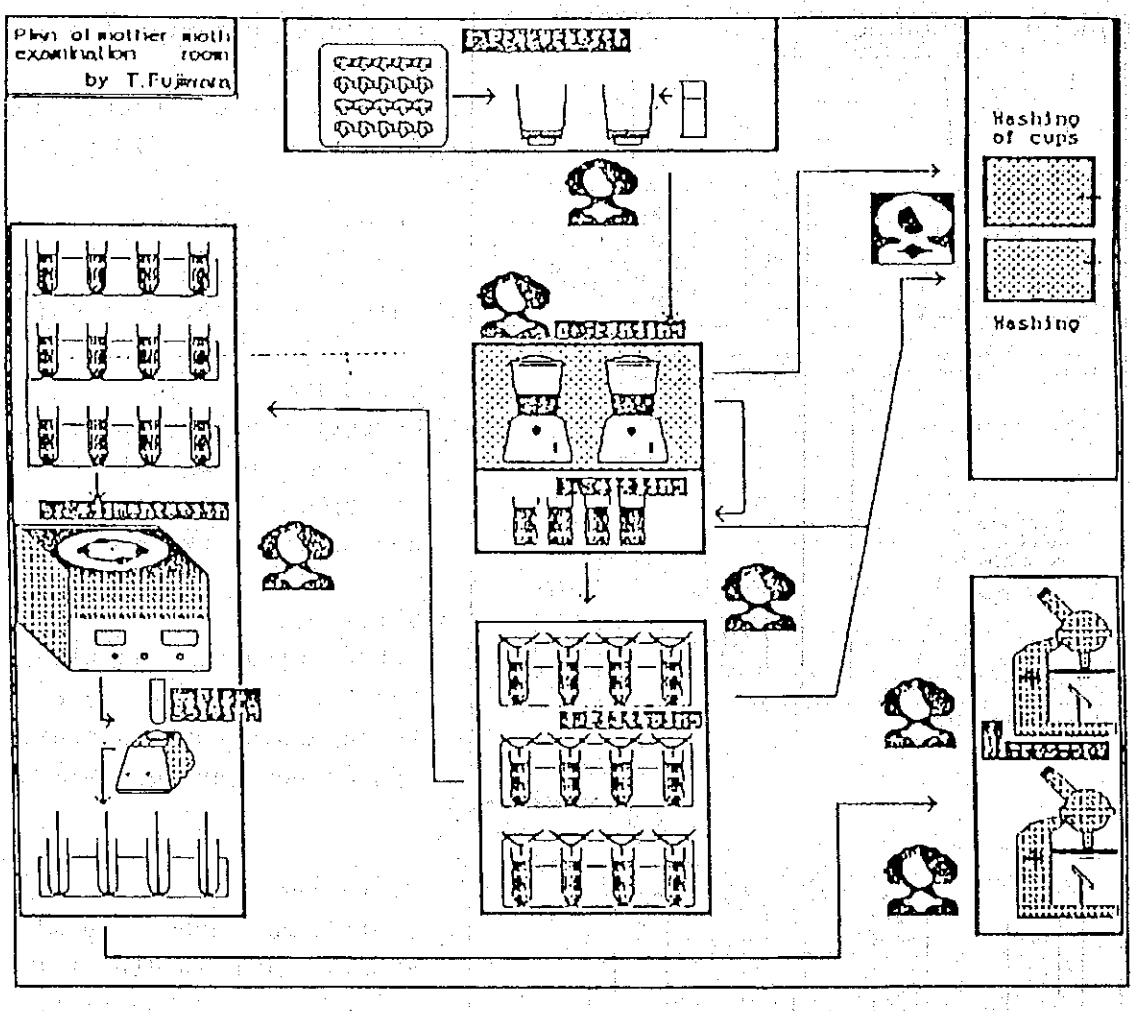
3. Settling
   After grinding, settling for 2~5 minutes in glass to separate host tissues. (pH of homogenate : 9~10)

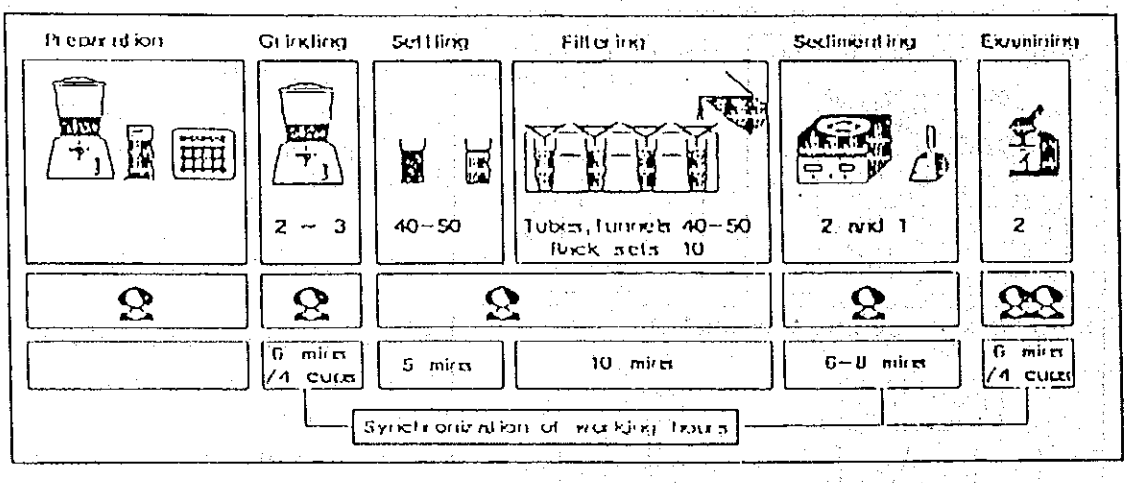
4. Filtering
   Centrifugal tube : 90ml
   Funel : 10cm in diameter
   Filter : Cotton cloth
   Volume of filterate:70ml

5. Sedimentation
   Sedimentation by centrifuging at 1500g for 3 minutes.

6. Dissolving of sediment

7. Microscopic examination
   5 fields per smear, two examiner.
   Recording of infected grade


Plan of mother cloth examination room
by T.Fujimura
Washing of cups
Washing


Preparation
Grinding
Settling
Filtering
Sedimenting
Examining
2 ~ 3
40~50
Tubes, funnels 40~50
flask sets 10
2 and 1
2
6 mins /4 cups
5 mins
10 mins
6~8 mins
6 mins /4 cups
Synchronization of working hours

1. **Preparation of materials :**

20 moths from one egg sheet Homogenising solution : 0.6% potassium carbonate solution Volume of solution : 80 ml per 20 moths.

2. **Homogenizing/Grinding :**

Homogenise the moths by using a mixer for 1-2 minutes at medium speed to separate the spores from the infected tissues.

3. **Settling :**

After homogenising, the contents are transferred into a plastic/glass beaker (250ml capacity) and allowed to settle for 2-5 minutes to enable separation of host tissues (optimum condition is pH 9-10 of homogenate).

4. **Filtering :**

The separated layers are slowly filtered, avoiding mixing up of the two layers, through a glass/plastic funnel (10 cm diameter) into a centrifuge tube (100 ml capacity). A muslin cloth in four layers is used while filtering the homogenate. The volume of filtrate recovered will be around 70 ml.

5. **Centrifugation/Sedimentation**

All the centrifuge tubes are evenly balanced, capped and loaded into the centrifuge followed by centrifugation at 3000 rpm for five minutes.

6. **Suspension of sediment**

The centrifuge tubes are removed from the centrifuge, supernatant is discarded slowly. The sediment is suspended by shaking with a few drops of clean water or by using a cyclomixer or a glass rod which facilitates uniform dissolving.

7. **Preparation of smear and Microscopic Examination**

From each tube three smears are drawn on to the microslide to be examined by two examiners. From each smear, a minimum of 5 microscopic fields are examined, one at the centre position and one each at 3 O'clock, 6 O'clock, 9 O'clock and 12 O'clock positions.

8. **Recording of intensity of infection**

Depending on the intensity of spores visible per microscopic field, the infection intensity is graded and recorded as indicated below.

No. of spores/field	Grade
1 to 3	±
4 to 10	1 +
11 to 30	2 +
31 to 100	3 +
101 to 300	4 +
301 and above	∞

9. **Reuse of Mixer cups, tubes, funnels, beakers, etc.**

The mixer cups after use are run again with 30 to 40 ml of 1% Potassium Carbonate solution, kept immersed in 5% bleaching powder solution for 10 minutes followed by washing with soap and water. Similarly, all the other materials utilised during centrifugation, filtering are sterilized in 5% bleaching powder solution for 10 minutes, washed using soap and water, then re-used.

Monitoring of pebrine disease

I. Examination of dust from silkworm rearing and egg production centre

1. Dust to be collected from the silkworm rearing house, egg production centre and equipments.
2. Dust samples are to be crushed in 0.5% Potassium Carbonate solution in a mixie (1:4).
3. After settling, filtering and centrifuging, the sediments are examined microscopically.

II. Examination of egg shells/unhatched eggs

Eggs which have attained body pigmentation/hatched egg shells/unhatched eggs are collected into a porcelain/glass mortar and 0.5% Potassium Carbonate solution is added and ground thoroughly (1:4 ratio of eggs to volume of solution). The rest of the procedure is followed as described above.

III. Examination of larvae

Young age larvae

1. Larvae which are weak, undersized, larvae not settling for moult and dead larvae are collected and starved overnight to keep the digestive tract devoid of food.
2. Larvae collected are to be homogenised by adding 80 ml of 0.6% Potassium Carbonate solution in a mixer.
3. After settling, filtering and centrifuging, the dissolved sediments are examined microscopically.

Late age larvae

1. Larvae which are lethargic, undersized, not preparing for moult (or dead ones) are collected and starved preferably for more than 6 hours. Midgut is removed from individual larva and the whole sample from a particular batch is collected into a mixer cup and ground for 1 to 2 minutes after the addition of 1% Potassium Carbonate solution (More than 4 times the weight of the sample). If the sample appears too viscous a few drops of hydrochloric acid may be added.
2. After settling, filtering, centrifuging the dissolved sediments are examined microscopically.

IV. Examination of pupae

1. Ten pupae are homogenised by adding 90 ml of 0.6% Potassium Carbonate solution in a mixer.
2. After settling, filtering and centrifuging, the dissolved sediments are examined microscopically.

V. Examination of first eclosion moths

1. Female and male moths eclosed on the first day are to be examined by the method of mass moth examination.

VI. **Examination of litter**

1. 5 gms of litter is collected in a mortar and 40 ml of 0.6% Potassium Carbonate solution (8 times the weight of litter) is added and homogenised by grinding. If the resultant homogenate turns out to be viscous, a few drops of HCl is added to reduce the viscosity.
2. After settling, filtering and centrifuging the dissolved sediment is examined microscopically.

Disinfection and cleaning

1. **Room floor**

   Disinfection and cleaning by sobing with 5% bleaching powder solution.

2. **Mixer cup and glass or plastic wear after use**

   Wash with 2% bleaching powder solution and wash with water.

3. **Equipments, etc. when work is over everyday**

   Sterilize with 5% bleaching powder solution for 10 minutes (If white patch is visible, rinse with 20% HCl solution) and wash with water.

4. **Refuse from examination**

   After disinfecting with bleaching powder, dump in a pit.

Maintenance of Mixer cup

Frequently remove the mixer blade by turning in an anticlockwise direction, clean and apply oil frequently.

At present according to the Seed Legislation Act, Karnataka 1959, 20% of the moths have to be tested for the production of commercial seed. This can be made more accurate if we follow the improved method as suggested in this manual.