Sl. No.	Item	Brief description of the work	Goal of achievement	Mode of measurement	Remarks
d)	Development of preservation schedules	Based on the studies conducted on hibernation, chilling and acid treatment, the suitable schedules will be formulated for egg preservation.	Standardization of schedules for short and long term preservation of eggs.	Analysis of hatchability, rearing performance and cocoon yield.	
(2)	Development of Seed crop rearing techniques				
a)	Development of mulberry package for seed crop rearing	The study involves identification of suitable mulberry varieties, method of plantation and agronomical practices suitable for seed crop rearing.	Package of practices of mulberry cultivation for seed crop rearing.	By rearing and analysis of quality and yield of seed cocoons.	
b)	Development of young and late age silkworm rearing technology for seed crops	Studies on chawki rearing method, quality of feed, quantum of feed and optimal environmental conditions required for seed cocoon crop.	Standardisation of seed crop rearing technology.	Growth of silkworm during young and late age & analysis of quality and yield of seed cocoons.	
(3)	Development of pebrine control practices for seed production centres				
a)	Field survey	Survey on the seasonal occurrence, pathogenicity and intensity of pebrine disease in seed multiplication farms, seed area, selected seed farmers and grainages. Data generated from	To forewarn occurrence of pebrine in seed area, in different seasons in order to take appropriate control measures.	Data analysis and periodicity of pebrine occurrence.	

Sl. No.	Item	Brief description of the work	Goal of achievement	Mode of measurement	Remarks
		field sampling test will be analysed according to season and area so as to formulate approximate forecast on the probable occurrence of pebrine disease.			
b)	Development of sampling and moth examination techniques.	Studies will be conducted to formulate a suitable method for collection of sample, moth examination and identification of pebrine in basic and commercial egg production centres.	Standard procedure of sampling and examination of mother moths for accurate detection of pebrine disease.	Efficacy of the sampling method will be assessed by subsequent rearing of the batches upto III moult and microscopic examination of egg shell, uneven larvae, late moulters, dead worms and faecal matter.	
c)	Development of pebrine control package for seed production centres.	A comprehensive manual will be formulated for proper moth examination in the production of disease free eggs in basic as well as commercial seed production centres.	Development of Moth examination system for production of basic and commercial seed.	Testing for pebrine disease occurrence in the subsequent rearing under field condition.	
(4)	Development of mass egg production technology of bivoltine eggs				
a)	Development of loose egg production	Studies on cocoon preservation, various events in loose egg preparation such as preperation of starched egg sheets, egg laying, loosening of eggs collection, removal of	To develop standard technique for loose egg preparation.	Uniform hatchability and rearing performance.	

Sl. No.	Item	Brief description of the work	Goal of achievement	Mode of measurement	Remarks
		glue, washing, drying, surface disinfection separation of unfertilised eggs, acid treatment and standardising the egg number for different seasons will be conducted.			
	b) Studies on incubation methods	Studies involve the method of incubation, requirement of environmental conditions viz., temperature, humidity and photo period, care during incubation and uniform development of embryo.	To standardize the method of incubation under tropical condition.	- do -	
	c) Development of packing and transportation techniques of eggs	Studies on suitable packing materials, method of packing, transportation of eggs for short and long distances, maintenance of humidity and care required during transportation, fabrication of suitable packing and transportation container, will be made.	To develop the egg transportation techniques.	By testing, hatching, state of embryonic growth and rearing result.	

Sl. No.	Item	Brief description of the work	Goal of achievement	Mode for measurement	Remarks
d)	Field trials	The developed techniques will be tested in large scale egg production centre.	For improving the existing method of bivoltine egg production.	By assessing hatchability and crop results.	
e)	Development of production programme and package for seed production centre	Based on the findings of all the above, studies an integrated package for cocoon processing, egg handling and grainage management will be compiled in the form of manual for egg production.	Preperation of guidelines and planning programme for bivoltine seed production.	Application of the system and analysis of performance results.	

別添４

計画打合せ調査団ミニッツ：
主要事項及び詳細協力実施計画（和訳）

インドニ化性養蚕技術開発計画に係る
計画打合せ調査団とインド政府関係当局との間のミニッツ（和訳）

ＪＩＣＡによって組織され、蚕糸・砂糖類価格安定事業団島田俊弘理事を団長とする計画打合せ調査団は、インドニ化成養蚕技術開発計画の実施に係る主要な問題について協議すると共に、当プロジェクトの技術協力のために１９９１年４月１６日に署名されたＴＩＰ（暫定実施計画）に基づく詳細協力実施計画を策定するために、１９９２年３月１５日から３月２５日までインドを訪問した。

インド滞在中、本調査団は関係当局と意見を交換し、一連の協議を行った。

その協議の結果、両者はそれぞれの政府に対し、別添Ｉに掲げられたような主要合意事項が検討され、当プロジェクトの円滑かつ成功裡の実施に向けて必要な措置が取られることを勧告することに合意した。

両者は、当プロジェクトの現段階において、ＴＩＰを可能かつ適切な範囲で明確化するために、別添ＩＩに掲げられたような詳細協力実施計画を共同で作成した。本詳細実施計画は、本プロジェクトの実施の過程で必要が生じた時に、１９９１年４月１６日に署名されたＲ／Ｄ（討議議事録）の枠組みの範囲内で変更されることがある。

ニューデリー
１９９２年３月２４日

署名	署名
島田俊弘	Ｐ．Ｓ．Ｓ．Ｔｈｏｍａｓ
計画打合せ調査団団長	インド繊維省中央蚕糸局事務局長

主要合意事項

Ｉ．投入活動

１．建物及び設備

本プロジェクトのためにインド側によって提供されるべき建物及び設備の工事は、既に派遣されている全ての日本人長期専門家が本格的に活動を開始できるように、促進され、これ以上の遅滞なく、完全に利用可能な状態で完了されるものとする。

２．機材

日本側によって年次ごとに供与される機材の調達・船積みの手続きは促進されるものとする。

インド側は、当プロジェクトに必要な機材の全体計画を日本人チームリーダーと相談の上、適切な優先順位を付して速やかに作成し、ＪＩＣＡのプログラムによってカバーされない全ての必要機材を調達するための措置を時期を失することなく取るものとする。

ＩＩ．プロジェクト活動

１．実用的な技術の指向

日本人専門家とインド側カウンターパートは両方とも、本プロジェクトの目的は、Ｒ／Ｄにも明記されているように、インドの環境下における二化性養蚕に要求される実用的技術を開発することであることを、常に念頭に置くものとする。

ＩＩＩ．プロジェクトの運営管理

１．要請書の提出

インド側は本プロジェクトの実施に必要な要請書（Ａ１、Ａ２－Ａ３、Ａ４）を十分に前広に提出するものとする。

２．プロジェクトの自立発展性

本プロジェクトの自立発展性を達成するための条件、あるいは本プロジェクト成功のための不可決の条件は、合同委員会、四半期毎のレビュー・ミーティング等を通じて、本プロジェクト運営管理の継続的なプロセスとして、特定され、取り組まれ、吟味されるもの

とする。

ＩＶ．その他

１．コストシェアリング研修

本プロジェクトに関連したインド人職員の日本における集団研修について１９９１年４月１６日に中央蚕糸局（ＣＳＢ）当局とＪＩＣＡ調査団との間で署名されたミニッツに関し、ＪＩＣＡコストシェアリング研修計画に基づく集団研修のためのインド側要請が、最大１０人で年１回の短期間（２－３週間）の視察旅行であり、かつそのための正式要請がインド側から日本側に適切なルートを通じ十分に前広に提出されることを条件として、当該要請に対し、日本側は好意的な配慮を与えるものとする。

仮にインド側が独自の予算と手配により（即ち完全にＪＩＣＡのプログラムとは切り離して）研修員を日本へ送ろうと計画する場合には、インド側はそのような研修が当プロジェクトの円滑かつ効果的な実施を決して妨げないことを保証するものとする。

詳細協力実施計画（和訳）

（ミニッツ　別添Ⅱ）

項　　目	活　動　内　容	達　成　目　標	測　定　方　法
1．蚕育種技術の開発			
(1)　事前基礎調査			
a）実態調査	インドの丘陵地帯、平地、高原、冷涼な月雨季、夏季等種々の農業環境条件下における蚕の品種、雑種の評価。完全な調査(karnataka丘陵、平原)、(andrapradeshの冬の平原、雨季から秋)	インドの環境の実態、インドの交雑種及び原種の欠点の同定	データの分析と結果
b）現存する二化性蚕原種の評価	インドの原種の可能性と欠点の評価	インドの二化性蚕原種の弱さと改良見通し	データの分析と結果
c）現存する二化性交雑種の評価	インドの条件下におけるインド種と日本種の比較	特定の形質の改良計画の適用 弱点の同定と改良に留意しながら地域の決定	データの研究と結果
(2)　蚕育種手法の開発			
a）蚕育種手法の評価	初期に行われた蚕育種手法の研究と評価	初期の蚕育種法の欠点と短所の同定	
b）新規・蚕育種法の開発	最適な違った蚕育種手法の研究	インドの条件下で強健性と多収の蚕の開発	既存の原種と比較
(3)　蚕原種の育成技術の開発			
＊a）強健性蚕品種の育成	高温耐性のある既存の原種の選抜と育種への利用	インドの環境下で強健で収繭量の多い原種の開発	既存の原種との比較
＊b）多糸量蚕品種の育成	多糸量で適切な原種及び交雑種の同定と育種への利用	多糸量の原種を進化させる	飼育成績と繰糸成績の分析
＊c）糸質優良な蚕品種の育成	小節の少ない細繊度の原種及び交雑種の同定と育種への利用	a）インドの市販二化性蚕原種の欠点の除去 b）小節点90～92％と均一な糸の蚕品種	データの分析と評価 データの分析と評価
d）蚕品種の系統維持法の開発	品種維持法の研究	品種固定時の水準の確認と開発した原種の維持法の開発	
(4)　蚕交配技術の開発			
a）交雑種組合せ手法の開発	種々の育種材料の組合せと目的形質を持つ系統の開発	交雑種の能力の同定	データの分析と評価
＊b）交雑種の評価法の検討	平地及び丘陵地帯のRSRSでの交雑組合せの実行	交雑種同定 a．高生存率と高収繭量 b．多糸量 c．優良糸質	データの分析と評価
c）交雑種の選抜	平地及び丘陵地帯における研究所と農家での適応性検定	平地、丘陵地帯及び季節に適合する交雑種の同定	データの分析と評価
＊2年後に定量化する。			

項　　目	活　動　内　容	達　成　目　標	測　定　方　法
2．蚕病防除技術の開発			
(1)　現場調査			
a）現場調査	養蚕農家ほか関連施設等における蚕病病原の存在及び発病実態の季節別実態調査	蚕病の発生予察	調査成績の解析
(2)　ウイルス病の診断法の開発			
a）ウイルス病原の採集と分離	ウイルス病原の採集，精製，及び同定	ウイルスの精製と同定	顕微鏡観察による
b）ウイルス病原の生物学的検定法の確立	ウイルス病蚕の組織病理学的特徴の究明	ウイルス伝染性の確定	組織学的特徴観察の反復による
c）血清学的診断方法の検討	ウイルス病の免疫血清学的な診断方法の開発	ウイルス病検出のための診断方法の開発	診断器具による病気の診断
(3)　ウイルス病防除法の開発			
a）感染性及び病原性の調査	蚕の各齢期別のウイルス感染量及びLDso値並びに不活性化の究明	蚕の各齢期別の感染性、伝染性の喪失及び病原性の決定	ウイルスの感染量，LDso値及び不活性化量の検定
b）消毒技術の検討	インドの飼育条件下において各種ウイルス病原の不活性化に効果のある消毒剤及び蚕座消毒剤の検討	インドの飼育条件下でウイルス病に効果のある蚕座消毒法及び消毒剤の確定	養蚕農家における消毒剤及び蚕座消毒の検定
c）ウイルス病防除指導書の策定	上記の各種試験成績を基にウイルス病防除指導書の策定	養蚕農家におけるウイルス病防除のための指導書の策定	現場の成績の集積と解析による
(4)　微胞子虫病診断方法の開発			
a）病原微胞子虫の採集と分離	蚕及び野外昆虫に病原を示す微胞子虫類の採集	蚕及び野外昆虫における微粒子病罹病虫の採集と精製	顕微鏡観察及び生物検定による
b）微胞子虫類の同定	微胞子虫類の形態学的、組織病理学的観察並びに感染性の検定による確定	微胞子虫類の形態学的及び組織学的同定	病理学的な検定及び組織学的研究による
c）免疫血清学的診断方法の検討	各種微胞子虫類による感染蚕の免疫血清学的手法による診断方法の開発	異種微胞子虫類を同定するための診断器具の開発	異種微胞子虫類に罹病した蚕の診断器具による同定
(5)　微胞子虫病に対する防除方法の開発			
a）感染性及び病原性の調査	各種微胞子虫類の蚕に対する感染量及び伝播様式の生物検定法による究明	異種微胞子虫類の感染量及び感染様式の確定	感染量及び感染様式の検定
b）消毒方法の検討	微胞子虫類の不活性化に有効な各種化学薬品や消毒剤の選出	微胞子虫類の防除に適した消毒剤及び化学薬品の確定	飼育実証による効力の検定
c）微胞子虫病防除技術指導書の策定	上記の各種試験を基に微胞子虫病防除のための技術指導書の策定	微胞子虫病の防除のための指導書の作成	現場の成績の集積と解析による
d）微粒子病検査方法の開発	蚕の各発育段階における的確な微粒子病検査法の策定	感染検出のための微粒子病検定技術の開発	検査技術の適合性の検定

項　　目	活　動　内　容	達　成　目　標	測　定　方　法
3．蚕飼育技術の開発			
(1)　稚蚕飼育技術の開発			
a）現場調査	異なった気象地域における稚蚕飼育の実態調査	稚蚕飼育現場における問題点や欠点の抽出	調査成績の分析と結果の摘出
b）稚蚕用桑の飼料価値調査	K2、S13、S36、S34、S54などの各種桑品種について、インド及び日本の交雑蚕品種を用いた生物検定法による飼料価値の調査	稚蚕飼育に適した桑品種の確定	飼育成績の分析
c）飼育方法の開発	箱育、積みあげ育、包み育などの各種稚蚕飼育法の実地試験	インドの環境条件に適した飼育法の開発	飼育実証と、作柄の分析
d）稚蚕飼育指導書の策定	稚蚕飼育指導書の策定	上記の(a)、(b)、(c)をもとに稚蚕飼育法の標準化	飼育体系の適用と飼育成績の分析
(2)　壮蚕飼育技術の開発			
a）現場調査	異なった気象地域における壮蚕飼育の実態調査	壮蚕飼育の現場における問題点や欠点の摘出	調査成績の分析と結果の摘出
b）壮蚕用桑の飼料価値調査	K2、S13、S36、S34、S54などの各種桑品種についてインド及び日本の交雑蚕品種を用いた生物検定法による飼料価値の調査	壮蚕飼育に適した桑品種の確定	飼育成績の分析
c）条桑の運搬・貯蔵方法の開発	湿度の保持能力の改善等による条桑の運搬・貯桑方法の開発	条桑に適した輸送法及び貯蔵法の開発	飼育実証の分析
d）条桑給与方法の検討	条桑給与、全葉給与などについて給桑回数等を変えた試験の実施	適切な給桑法及び給桑回数の確認	収量及び繭質の分析
e）飼育環境管理方法の検討	各蚕期に飼育室内の温度及び湿度などを変えた試験の実施	飼育室に温湿度を適切に維持する方法	飼育結果及び繭の形質
f）実用化試験	条桑育，全葉育などの各種飼育法を異なった気象条件の現場において実地試験	異なった気象条件に適した飼育法の確定	蚕の成育と飼育実証
g）壮蚕飼育指導書の策定	壮蚕飼育指導書の策定	上記の(a)、(b)、(c)、(d)、(e)をもとに壮蚕飼育法の標準化	飼育体系の適用と飼育成績の分析
(3)　上蔟・収繭技術の開発			
a）上蔟技術及び蔟器の開発	異なったタイプの蔟器を開発し、異なった上蔟体系のもとで実証	インドの条件に適した蔟器及び上蔟法の確定	繭質及び繰糸成績の分析
b）上蔟環境管理法の検討	上蔟に適した温度や湿度などの環境条件について異なった蚕期を通して試験	異なった季節における温湿度の上蔟に対する影響の確証	繭質及び繰糸成績の分析
c）収繭技術の開発	各種収繭法を試み，省力で能率的な方法を開発	適切な収繭方法の開発	収繭に必要な労力の分析
d）上蔟・収繭指導書の策定	上蔟及び収繭法の指導書の策定	上記の(a)、(b)、(c)をもとに上蔟及び収繭法の標準化	上蔟・収繭体系を適用し、繰糸成績を分析

項　　目	活　動　内　容	達　成　目　標	測　定　方　法
4．桑育種・栽培技術開発			
(1)　稚蚕用栽培技術の開発			
a）稚蚕用桑の育種方法の研究	インディカと外国種の交雑と他の育種法	種々の育種法による適切な稚蚕用桑の開発	75～80％の水分率と2齢で90％以上脱皮する稚蚕用桑の開発
b）稚蚕用桑品種の選定	苗木選抜	苗木選抜過程の標準化	10％選抜するための効果的な方法
c）栽培技術の開発	品種、植付距離、施肥、灌漑の試験	植付距離、施肥、灌漑に関するパッケージの確立	既存の桑より良質で20％増収
d）収穫・搬送技術の開発	全芽育の試験、トラクタかティラーによる運搬	効率的な収穫法と萎凋を防ぐ運搬法	収穫時，運搬時の湿度低下
e）実用化試験	地域適合品種選抜のための系統適応性検定	地域適合品種の確定	
f）標準技術指導書の策定	試験結果から編纂	全ての部面の勧告の編集	小冊子の発行
(2)　壮蚕用栽培技術の開発			
a）実態調査	各地域の調査	慣行法の理解	地域別の低生産性の把握
b）桑育種方法の検討	インディカと外国種の交雑と他の育種法	種々の育種法による壮蚕用桑品種開発	既存の品種より15％増収（35MT／ha／yr）
c）（壮蚕用桑品種）選定	苗木選抜	苗木選抜過程の標準化	条桑収穫に適する形質、挿木増殖法の開発
d）栽培技術の開発	品種、植付距離、施肥、灌漑の試験	壮蚕用桑栽培法の確立	15％増収
e）収穫・搬送技術の開発	条桑収穫とトラクタかティラーによる運搬の試験	効率的な収穫法と萎凋を防ぐ運搬法	葉摘みに対する条桑収穫の利点。迅速な搬送方法
f）桑園改造技術の開発	農家の条件下での試験	既存桑園の改造法の開発	農家の桑園との比較
g）実用化試験	多数の地域で適合品種の選抜	諸農業気象条件下で選抜した品種群の推奨	地域適応性品種の推奨
h）標準技術指導書の策定	試験結果から編纂	全ての部面の勧告の編集	小冊子の発行

項　　目	活　動　内　容	達　成　目　標	測　定　方　法
5．蚕種製造技術の開発 (1)　蚕種保護技術の開発 a）蚕卵に関する検討	各種蚕品種について各種気象条件下で胚子の成育を調べ、保護に適した胚子の発育段階や期間の究明。卵の越冬中における休眠物質の生化学的変化について理解を深めるための酵素分析	越冬卵の貯蔵に適した胚子発育段階の確定。越冬期における生理学的及び生化学的変化の決定	各種気象条件下における胚子発育段階の明確化及び酵素分析による。短期専門家の着任を待って活動を実施
b）越年保護技術の開発	休眠中の温度、湿度、光、及びその後の冷蔵などと胚発育、孵化、飼育成績などとの関係の究明	異なった卵保護期間別の予定表の作製	胚子発育、孵化率及びその後の生物検定による
c）冷蔵・浸酸処理技術の開発	バラ種の人工孵化に適した冷蔵と浸酸を組合せた処理法の究明	短期冷蔵及び浸酸法の開発	孵化率及び安定した繭生産実証の評価による
d）蚕種保護管理工程の策定	越冬、冷蔵及び浸酸などの研究をもとに卵保護に適する管理工程の標準化	蚕種の短期及び長期保護法の標準化	孵化率、飼育実証及び収繭量の分析
(2)　原蚕飼育技術の開発 a）種繭養蚕向け栽桑法の開発	種繭用の原蚕飼育に適した桑品種の選定、栽植、肥培管理法等の究明	原蚕飼育のための桑栽培法の体系化	飼育及び種繭の品質と収量の分析
b）種繭用稚蚕・壮蚕飼育技術の策定	種繭生産に合った稚蚕飼育法、葉の質、給与量、最適環境条件などの究明	原蚕飼育技術の標準化	稚蚕及び壮蚕の成育並びに種繭の品質と収量の分析
(3)　蚕種製造所における微粒子病防除法の開発 a）現場調査	蚕種製造所やその地域における微粒子病原の季節的変動、病原性、感染度などの調査。各蚕期別や地域別の採取検定による微粒子病の発生調査	種繭生産地帯における蚕期別の微粒子病発生調査と適切な防除法の適用	成績の分析及び微粒子病発生の周期性の調査
b）母蛾検査技法の開発	原蚕種及び交雑蚕種製造所における適切な検査資料の採取法、母蛾検査法、正確な微粒子検定法の検討	微粒子病の正確な検出のための母蛾検査とサンプリングの標準的手法	サンプリング法の有効性について3齢以降の飼育成績並びに卵殻、遅れ蚕、死蚕、糞等の顕微鏡観察による評価
c）蚕種製造所向け微粒子病防除指導書の策定	原蚕種及び交雑蚕種製造所における無病原蚕種の生産のための厳密な母蛾検査法を明らかにし包括的な指導書の策定	原種及び普通蚕種の製造における母蛾検査体系の開発	飼育現場における微粒子病の検定とその後の飼育成績との関係

項　　目	活　動　内　容	達　成　目　標	測　定　方　法
(4)　蚕種大量製造技術の開発 a）バラ種製造法の開発	繭の貯蔵、糊付け産卵台紙の準備、産卵、バラ種の収集、糊の除去、洗浄、乾燥、卵面消毒、不受精卵の選別、浸酸、卵数の規格統一化など、バラ種製造のための諸手法について各蚕期ごとの検討と、バラ種製造の標準技術の体系化	バラ種製造の標準法の開発	孵化の均一性及び飼育実証
b）催青手法についての検討	催青の方法、温度、湿度、光周期などの催青に必要な環境条件、催青中の留意点及び胚子の成育を斉一化させる手法等の検討による熱帯条件下における催青手法の標準化	熱帯条件下における催青手法の標準化	孵化の均一性及び飼育実証
c）蚕種包装・運搬技法の開発	蚕種の包装に適した資材、包装方法、短距離及び長距離の運搬、湿度の保持及び運搬中の取扱い、包装方法及び運搬容器などの開発	蚕種輸送技術の開発	孵化率、胚発育状態及び飼育成績の検定
d）実用化試験	開発された技術を組合わせ蚕種製造所において大規模な実証	二化性蚕種生産のための既往の技術の改善	孵化率及び蚕作の結果による評価
e）蚕種製造所向け製造工程・管理技術書の策定	上記の各種試験から得られた知見をもとに、繭生産、蚕種の取扱い、蚕種製造所の管理について、蚕種製造のための技術書として編集	二化性蚕種製造のための標準表の作製	蚕種製造工程の体系適用及び実証試験の結果の分析

Detailed Implementation Plan (Draft)

6. DEVELOPMENT OF SILK REELING TECHNOLOGY (PROJECT SITE－C.S.T.R.I. BANGALORE)

Sl. No.	Item	Brief description of the work	Goal of achievement	Mode of measurement	Remarks
(1)	Development of cocoon testing, drying and storage technology				
a)	Field survey	Field survey has been conducted in respect of silk filatures, cocoon markets and private reeling units in Karnataka and Andhra Pradesh.	Collection of information pertaining to the existing method and problems theron to achieve quality and productivity.	Analysis of data and results.	Since long term expert is not available, the work could be taken up only during Feb. 1992 after the arrival of the short term expert (STE).
b)	Development of cocoon testing programme	CSTRI multiend reeling unit has been incorporated with filament length gauge and stroke guage to measure the filament length and casting frequency of cocoons respectively. Evaluation of the test reeling method to develop the cocoon testing programme has been taken up with defferent quality commercial bivoltine cocoons.	A cocoon testing programme suitable to Indian condition would be developed.	By incorporating the gadgets to measure the cocoon characteristics,the characterisation of Indian bivoltine cocoons would be done.	Since there is no provision for a LTE under the area of work, the programme has been started after the arrival of STE in reeling. Similarly,it is proposed to extend the studies by one more year i.e., 1994－95.
c)	Development of cocoon drying and storing technology	Commercial bivoltine cocoon lots would be procured from the cocoon markets. These would be hot－air dried at different temperatures for different durations to achieve different degree of driage viz., 20(%), 30(%) and 55－60(%), Subsequently these cocoons would be studied for storage period and conditions.	To optimise the conditions of hot air drying vis－a－vis storing of cocoons.	The cocoons after driage are stored under different conditions.These would be test reeled to assess the reeling performance and quality of silk.	As per TIP, this programme has to be started from the year 1992－93. Accordingly, the plan of work has been drawn in consultation with STE.

Sl. No.	Item	Brief description of the work	Goal of achievement	Mode of measurement	Remarks
(2)	Development of reeling technology:				
	a) Field survy	Field survey has been conducted covering a few Government and Private reeling units, silk exchange, cocoon markets, weaving factory and twisting unit.	Understanding of the existing level of technology and problems in the processing for concieving the project.	Analysis of data and findings.	The studies have been taken up after the arrival of STE. These studies would be extended as per TIP for the year 1992－93.
	b) Development of cocoon cooking techniques	Based on the survey as also the studies conducted earlier, the work has been initiated. The studies include cooking by single pan, three pan, conveyor type pressurised cooking. And bathch type pressurised cooking. According to STE, standard cooking procedure is not possible for all the qualities and slight modification has to be done depending on the quality of cocoons. Accordingly,it has been planned to take up studies on cooking by three pan cooking method.	To develop, appropriate cooking method suitable to Indian bivoltine cocoons.	Test reeling of cocoons and assessment of quality of silk.	As per TIP, the programme has to be started from 1993－94. As and when the STE arrives, the programme would be intensified.

Sl. No.	Item	Brief description of the work	Goal of achievement	Mode of measurement	Remarks
	c) Development of raw silk reeling technology	Based on the survey conducted by STE with Indian C/P and also on the basis of the studies already conducted in India, it has been envisaged to conduct further studies on CSTRI multiend reeling machine. Suitable gadgets for denier control and stroke counter have been fixed on the machine.Studies would be conducted with the above modification by using different quality Indian bivoltine cocoons.	Suitable modifications of the machine and process parameters, to workout appropriate reeling technology for bivoltine cocoons to achieve the production of superior grade silkyarn.	Cocoons would be reeled on the modified machine and the reeling performance and quality of silk would be assessed.	As per TIP, this programme has to be taken up from 1993-94. As and when the STE/LTE is made available for the purpose the implementation would be intensified.
	d) Development of raw silk re-reeling technology	Pre-soaking of small reels with defferent soaking agents, reel permeation at low pressure, and reeling speed of yarn would be studied.	To develop a proper rereeling technology so that the quality of bivoltine silk could be improved.	The performance and quality of silk would be evaluated.	As per TIP, the programme has to be started from1994-95. As and when the STE/LTE is made availab[illegible], the programme would be taken up.
(3)	Development of silk testing technology :				
	a) Field survey	A survey has been conducted on the testing methods and quality aspects of Indian silk in silk filatures, twisting and weaving units, silk exchange, silk conditioning and testing houses of CSB and Govt. of Karnataka, and CSRTI laboratories.	To understand the existing testing procedures and the quality of Indian silk.	Analysis of data and findings.	The work has been taken up after the arrival of STE (testing).Field survey will be extended for one more year as per TIP.

Sl. No.	Item	Brief description of the work	Goal of achievement	Mode of measurement	Remarks
b)	Studies on raw silk conditioning methods	Studies have been taken up to estimate the conditioned weight of raw silk by defferent methods. Moisture content of silk will be estimated by conditioning cabinet, electronic sensor, infrared moisture balance and dessication method.	Standardization of raw silk conditioning method for implementation in raw silk markets.	Based on the moisture data, the conditioned weight of raw silk will be estimated.	Presently standard conditioning cabinet is not available at the project site. As per the suggestion of SITE (testing), attempts are being made to get the same fabricated locally. Dr. Ishii, STE (testing) has already sent the diagrams of the conditioning cabinet. Due to the non-availability of the equipment, the programme has been shifted to 1992-93 under TIP by keeping the same duration.
* c)	Studies on raw silk testing and grading programme	Based on the survey and the work already conducted in India, studies on sampling of silk for testing and grading has been taken up. Similarly, for the purpose of evaluation of testing equipment, comparative studies on testing and grading by seriplane test and electronic tester uster I.S.model have been taken up. And comparative studies on cohesion testing by testers in India and Japan using the same raw silk sample have been also done.	To evolve suitable testing and grading methods for Indian silk.	Characterisation of silk by different methods of sampling and by evolved testing and grading methods would be done.	Since the project site is likely to receive testing and grading equipments by July-Aug 1992. The programme has been shifted under TIP so that project work could commence from 1992-93.

Sl. No.	Item	Brief description of the work	Goal of achievement	Mode of measurement	Remarks
	d) Development of design and operational manual for silk conditioning and testing houses	Five silk conditioning and testing houses are being established by CSB under NSP. Equipments are likely to arrive by July–Aug 1992. It is envisaged to workout suitable operational manuaal for these units so that the units can cater to the needs of sericulture industry in different parts of India.	Based on the above studies evolve a suitable operational manual for SCTH.	The manual thus evolved would be put to use in the silk conditioning and testing house and feed back information collected will be evaluated.	Since the programme could not be initiated during 1991–92, it has been proposed to shift to 1992–93. As and when STE (testing) arrives in India, the programme would be taken up.

＊Only this item has been slightly modified as per the comments by the Japanese short–term expert. However, this modification needs to be confirmed with the Indian counterpart.

詳細協力実施計画案（和訳）

6．製糸技術の開発

別添5（つづき）

項　　目	活　動　内　容	達成目標	測定方法	留　意　事　項
(1) 繭質評価・乾繭及び貯繭技術の開発 a）実態調査	カルナタカ州とアンドラ・プラデシュ州において器械製糸、繭市場及び民間製糸業者についての実態調査が行われた。	現在行われている方法に関する情報や品質・生産性向上の問題点の収集	データ及び調査結果の解析	長期専門家が派遣されていないので、活動は短期専門家の派遣後、1992年2月中だけ行われた。
b）繭質評価法の開発	繰糸試験による繭質評価方法を開発するため、マルチエンド繰糸機へ生糸糸長計及び接緒回数の計数機器が取り付けられ、繭市場から入手した繭の繭質が評価された。	インドの状況にあった繭質評価法が開発される。	繭質を評価するために取り付けられた計数機器類によってインド二化性繭の性状が評価される。	長期専門家が派遣されていないので、製糸の短期専門家の到着後、本課題は始められた。また、本課題の年次計画を1年延長すなわち1994－95年次までとすることが提案された。
c）乾繭及び貯繭技術の開発	二化性繭を繭市場から入手し、二化性繭の乾燥条件と貯繭期間との関係が検討された。すなわち、繭市場から二化性繭を購入し熱風乾燥機の温度及び時間をそれぞれ変え、乾燥程度を20%、30%、55－60%とした繭の貯蔵条件が検討された。	貯繭状態を考慮しながら熱風乾燥時の最適条件を見出す。	繭を乾燥して種々の条件で貯蔵した後、繰糸試験を行い繰糸成績及び生糸の品質を評価する。	TIPによれば、本課題は1992－93年次から始められることになっている。それゆえ、活動の計画は短期専門家と相談の上、作成された。
(2) 繰糸技術の開発 a）実態調査	公営及び民間の製糸工場、生糸取引・繭市場、織物工場及び撚糸業者の実態調査を行った。	現在の技術レベル及び計画策定に当たっての問題点の把握	データ及び調査結果の解析	調査は短期専門家の到着後始められた。本課題はTIPによれば1992－93年次まで行われる。

項　　目	活　動　内　容	達成目標	測定方法	留　意　事　項
b）煮繭技術の開発	実態調査やこれまで行われていた研究に基づいて煮繭方法の検討が行われた。煮繭装置は1鍋（PAN）、3鍋、コンベヤー型圧力煮繭及びバッチ型圧力煮繭の各方式についてそれぞれ検討された。短期専門家によれば、標準的な煮繭方法が全ての繭に適用できるのではなく、繭の性状に適する煮繭条件を見出すことの必要性が指摘された。それゆえ、まず3鍋方式による煮繭について検討することが計画された。	インドの二化性繭にとって適切な煮繭方法の開発	繭の繰糸試験成績及び生糸の品質評価	TIPによれば、計画は1993－94年次から始めることになっているが、短期専門家が派遣された時から本課題は重点的に行われた。
c）生糸の繰糸技術の開発	短期専門家とインド人カウンターパートにより行われた調査及び既にインドで行われている研究に基づき、CSTRIのマルチエンド繰糸機の改良研究が行われた。すなわち、マルチエンド繰糸機へ繊度感知器及び生糸糸長計が取り付けられ、インド二化性繭の品質向上方法が検討された。	繰糸機械の改良と適切な繰糸条件を見出し、二化性繭によって高格生糸を生産するための繰糸技術を策定する。	改良された機械を使って繰糸を行い、繰糸成績及び生糸の品質を評価する。	TIPによれば、本課題は1993－94年次から始められることになっている。短期または長期専門家が派遣された時には、この計画はより一層進められるであろう。
d）生糸揚返し技術の開発	種々の浸漬薬剤を使っての小枠の浸漬処理、低圧での小枠への浸透方法を検討する。	二化性生糸の品質を改善するために適する揚返し技術の開発	生糸の性状及び品質を評価する。	TIPによれば、本課題は1994－95年次から始められることになっている。短期または長期専門家が派遣された時から行われる。

項　　目	活　動　内　容	達成目標	測定方法	留　意　事　項
(3) 生糸検査技術の開発 a）実態調査	調査は、製糸工場、撚糸及び織物業者、生糸取引所、CSB及びカルナタカ州の生糸検査所並びにCSTRIの実験室において、検査方法及びインド・シルクの品質について行われた。	現在の生糸検査法及びインド・シルクの品質の把握	データ及び調査結果の解析	活動は短期専門家（生糸検査）の到着後始められた。実態調査はTIPに従って更に1年継続される。
b）生糸(総荷及び)正量検査法の開発	種々の方法により生糸の正量を決めるための検討が始められた。生糸の水分含量は、水分乾燥器、電子センサー及び赤外線水分計を使った乾燥法により計量されるであろう。	生糸市場での取引のための生糸(総荷及び)正量検査法の標準化	水分データをもとに、生糸の正量を決める。	現在，標準水分乾燥器はプロジェクト・サイトにはない。短期専門家（生糸検査）の助言により、地元で同じようなものを作成しようとする試みがなされている。短期専門家（生糸検査）石井博士は既に水分乾燥器の図を示している。機材が入手できないので、計画の実行はTIPの下に同じ期間内の1992－93年次に移された。
＊c）生糸検査及び格付け法の検討	実態調査及び既にインドで行われている活動に基づき、生糸の検査と格付けのためのサンプリングの検討が始められた。また、検査機器類の査定のため、セリプレーン検査とウースターテスターI.S.型による検査の比較、日本とインドのテスターによる抱合試験の比較の検討を始めた。	インドの生糸に適した検査法及び格付け法の開発	種々のサンプリング方法及び開発された検査方法による検査成績の評価を行う。	プロジェクト・サイトは生糸検査と格付けの機材を1992年の6、7月に受け取ることになる見込みなので、計画の実行はTIPの下にプロジェクトの活動が1992－93年次から始められるよう移された。
d）生糸検査所の設計と運営指導法の策定	5か所の生糸検査所が国家蚕糸計画の下にCSBによって設立されている。機材は1992年7、8月に到着する予定である。インドの種々の地域における蚕糸業のニーズに応えることができるよう、これらの検査所のための適切な運営指導マニュアルを作成することが計画されている。	上記の検討に基づき、生糸検査所のための適切な運営指導マニュアルが開発される。	策定されたマニュアルを生糸検査所で使ってみて、その結果に関する情報を集めて評価する。	本課題については、1991－92年次には開始できなかったので、1992－93年次から始めることが提案されている。短期専門家（生糸検査）がインドに到着した時、始められるであろう。

＊この項目のみ日本人短期専門家のコメントにより若干が修正された。しかし、この修正についてはインド人カウンターパートに確認される必要がある。

インドにおける1991年多化性蚕微粒子病の被害状況及びその対策の現状と課題

（参考：本調査団がCSBトーマス事務局長より聴取）

南インドの3州（全インド絹の８０～８５％を生産）の１９９１年8月から１９９２年１月における気候状況は、多量の雨という点で極めて例外的なものであった。微粒子病の病害発生状況をモニタリングするシステムはないため、入荷されてくる繭を検査するしかない。１９９１年１０月に第１回目の調査が行われ、その後第２回目も実施された。この結果、政府の蚕種製造所(Farm Grainage) の原蚕種（Basic seed）は、あらゆるレベルで２５％～４０％の罹病率であることが判明した。繭の入荷量は前年に比べて１５％減少し、絹の価格が１９９１年９月以降２５％～３０％上昇した。（但し、これは１９９１年７月のルピー切り下げも影響している。）しかし、関税率が５５％から３０％に引き下げられたこともあり、現在は絹の価格は下降している。

種繭養蚕地帯（Seed area ）は病気にかかった蚕種を食い止めるため、州の部局により規制されている。種繭は種繭生産者（Seed rearer ）→種繭市場→蚕種製造所のルートを通るが、Seed Area の消毒を強化し、病気を持った繭がGrainageに行かないようにすることが肝要である。現在も養蚕は進行中であり、病気の繭は除去されている。しかし、微粒子病対策は困難である。

微粒子病対策には次の３つのレベルがある。

①原蚕種製造農家（Basic seed Farm ）

②種繭生産者／種繭養蚕地帯（Seed rearers/ Seed zone ）

③蚕種製造所（Grainage）

まず、③のレベルでは、５００～６００のＬＳＰ（Lisenced Seed Preparer、免許を持った蚕種製造業者。Private ベースのもの）と州のGrainageがそれぞれ、５５％と４５％の蚕種を生産している。母蛾検査も厳格化される必要がある。ＬＳＰの問題は機材不足で、病害対策が十分できないことである。

②のレベルでは、衛生的な条件が悪く、かつ住居と分離された飼育舎がないため、農民が蚕と同居しており、密閉ができないため効果的、適切な消毒を困難にしている。更に、農民は飼育道具をお互いに貸借し合うため、借りた器具が消毒済のものか否か確認されないまま使用されることが多い。このレベルにおける消毒は州の部局が責任を有している。

カルナタカ州では州の消毒作業隊が無料で農家の消毒を行っている（他州は有料）。

以上の背景でSeed Zone の微粒子病対策改善は容易ではない。しかし、長期的観点から取り組まねばならない。

①のレベルはＣＳＢまたは州政府により運営されるものである。Ｐ１（原種）の段階から検査を行っている。ＣＳＢが果たせる最良の役割は、原産種製造農家に対して、次の数か月間に助言を行うことであり、この１～２週間で我々の指導プログラムを改訂したい。考えられる対策としては、次のようなものがある。

イ．Farm Officers （技術指導吏員）を訓練すること（特に検査能力）

ロ．Grainage(蚕種製造所) レベルにおける適切な検査方法の開発

母蛾検査は既に行っているが、より効果的な方法を開発する必要がある。検査機材や手続きが改善される必要がある。

ハ．Seed zone （種繭養蚕地帯）のSeed rearers （種繭生産者）は、カルナタカ州では１５，０００Rearers いる。気候的にカルナタカ州は他の州よりも種繭養蚕地帯に適している。しかし、ＣＳＢとしては蚕種地帯(Seed zone)レベルで何ができるか定かでない。

取り組む道は２つある。

イ．何がインドでは問題かという、より基礎的な種類の仕事（長期的措置）

例えば、種々の微粒子病の種類の確認、それらの蚕に及ぼす影響の特長、微粒子病に係るより詳細な研究等。

ロ．あらゆるレベルにおいて、より効率的な対策の開発（緊急措置）

あらゆるステップで詳細な研究を行い、どのような改善ができるかを検討する。

サンプリング方法、母蛾検査、病害防除に従事する職員の訓練、適切な検査方法・粉砕や遠心分離や顕微鏡検査の開発・採用。

これらの一つ一つについて、ＣＳＢがシステムを作り、州にあたえる。システムを実施するのは州である。彼らは資格を持った病理学者の配置を要望している。

夏のブレイクの後、すなわち２～３か月後の今年の微粒子病発生を抑えたい。雨期の期間中は養蚕活動は余り盛んでない。病気蔓延防止策の他の方法は、種繭の移動をしないことである。（但し、Basic seed（原蚕種は少し移動する。）インドの北西部は微粒子病がない地域がある。

緊急措置の一つとして、微粒子病管理計画（Disease Management Planning)のための日本側からの短期専門家の派遣を要請したい。

（当方は困難である旨回答。詳細は本文参照。）

インド多化性養蚕計画監理調査報告書

WORLD BANK
National Sericulture Project
India
(Cr. 2022/Ln. 3065-IN)

Supervision Mission

Report by
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26th August 1991

Introduction

1. According to the T.O.R (Terms of References) which were sent to me, the aim of my mission was to review in depth the consolidated action plan for bivoltine development with specific reference to site selection, seed production and supply, rearing technology, post-harvest technology, extension, research and the economics of production.

2. To this end, I visited several CSB (Central Silk Board) and State research centres, I have met DOS's (Departement of Sericulture) and an importing weaver, carried out field visits at farmers', reelers', egg production centres, CRC (Chawki Rearing Centres) and TSC (Technical Service Centre). Most of these visits took place in Karnataka but also in West Bengal and Tamil Nadu (see the appended list).

3. Throughout this mission I enjoyed total co-operation from the organisations and persons who received me as well as the invaluable help of Mr Balasubramanian who 'guided' me during the visits in Karnataka.

Preliminary remarks

4. The many data available as to the cocoon yields of pure races, bivoltine hybrids or cross breeds (CB) cannot be used for comparison. These data are indeed expressed in kg of cocoons/100 DFLs (disease-free layings). They should be expressed according to the number of eggs incubated or, better still, according to the number of eggs hatched. The international standard in this domain is the 'box' (20,000 eggs).

This is important because the number of eggs per laying varies considerably between races, between hybrids and between seasons (see Table I, appendix). Hence a 20 to 25 % difference in the cocoon yield expressed for 100 DFLs between two different productions cannot be considereed as significant.

5. In the earlier reports and statistics, it appeared that India imported about 2,000 tonnes of good quality raw silk (quality A or more), the objective of bivoltine production in India (and of the National Sericulture Project) was to reduce these imports through home production.

It appeared after an interview I had with a private weaver of Karnataka (Swan Silk Ltd.) that 70 % of raw silk imports were made up of doupion silk ! that out of the remaining 30 % , only 30 to 40 % were A and 2A raw silk and 60 to 70 % were grade B silk. Imports of quality raw silk (A, 2A) thus correspond to about 250 tonnes only.

6. This should be connected with the fact that in the 'Notes for the Fifth World Bank/SDC Review Mission', Karnataka Sericulture Project II indicates that bivoltine production of raw silk amounted to 1,719 tonnes in 1990-91 and that of bivoltine raw silk to 191 tonnes. This production should therefore meet most of the present demand, especially when adding the silk produced by other States.

If this silk is not used by the weavers (the representative of Swan Silk maintained that he could not find any bivoltine silk on the market), this is either because it is sold for handlooms and/or because it does not have the required quality.

7. The situation of the quality (grade) of the raw silk produced in India is not clear. There again, the results are not easy to interpret. They are partial, carried out on a small portion of the batches produced and often concern only 3 characters that are considered more important (denier, tenacity, winding breaks). Sometimes they are not in accordance with international standards (published by the International Silk Association).

However, if one refers to certain gradations, carried out as per the international standards in CSTRI (Central Silk Technological Research Institute of CSB at Bangalore), after reeling on an improved multiend reeling machine, the bivoltine raw silk is grade A and the multivoltine silk is grade C. Why then (points 5 and 6) ?

8. One last brief preliminary remark : the bivoltine strains I saw during my mission are in fact monovoltine strains. Under 'Indian conditions none of the strains I was shown gave non-diapausing eggs. Nevertheless, we will continue to term them bivoltine, for greater convenience -and out of habit.

Performances of reference of bivoltine strains.

9. The performances of bivoltine silkworm strains and particularly of hybrids are of course very different depending on the conditions.

In view of this, one should use as a reference the results obtained in the Research and Training Centres because rearings are carried out there under the best possible conditions in India (qualified staff, technology, equipment, quantitative check of the various parameters, etc.).

10. As an example, table II (appended) gives the performances of the bivoltine hybrids obtained at CSRTI of Mysore (CSB) under the bivoltine training programme for NSP/DOS Official. Similar results are also obtained at CSRTI of Berhampore (CSB) and KSSI (Karnataka State).

On average, the yield for 100 DFLs is observed to be within the region of 80 kg for a mean cocoon weight of 1.9 g and shell ratio of 19.9 %. For results expressed per box (20,000 hatched eggs), which is possible here since the number of larvae brushed is known, a yield of about 31 kg of cocoons is obtained.

11. This is not far from the results obtained at the international level with bivoltine silkworms. Single cocoon shell and shell percentage could be higher. This can also be observed, sometimes, for the same strains in some rearings performed in the Institutes where the cocoon weight can be as high as 2.2 g and the shell percentage 21.5 %. It should even be pointed out that during an intensive rearing programme at TSC of Bicharajuppe (Bangalore District) a yield of 92 kg/100 DFL's was obtained.

The bivoltine hybrids currently used in Karnataka, West Bengal and Tamil Nadu therefore have a potential which is in accordance with international standards.

12. If one compares the above results to the performances of the Cross Breeds (multi X bi) measured under the same conditions, one notes that they are not as good on average : 30 kg of cocoons/box of hatched eggs, single cocoon weight of 1.7, shell ratio of 17.9 %. Furthermore, the hatching percentage appears much poorer ; but this can vary a lot depending on grainage, preservation of the eggs, incubation conditions, etc. This is why the yield retained should be the figures expressed in relation to the number of silkworms brushed.

13. As regards the reeling characteristics of the cocoons, I used as a reference the standard results obtained on the multiend reeling machine of CSTRI of Bangalore (CSB).

Table III (appendix) clearly shows that the renditta and average filament length are significantly better for hybrid bivoltine cocoons than for multivoltine. Of course, these standard results are not established for all the cocoon batches tested at CSRTI (see table V appended). However it implies that such yields are possible and that hybrid bivoltine cocoons give better results than multivoltine and pure bivoltine strains. This was not what I was generally told during my visits to the reelers' because only the raw silk recovery (%) is taken into account.

Field observations.

Research Centres

14. The visit of Research Centres (CSRTI of Mysore and Berhampore and KSSDI) enabled me to note that the general technology of bivoltine sericulture was well known and established in these centres : high-yield mulberry varieties, management of mulberry gardens (manure, irrigation, sapling, cutting), rearing techniques (temperature, humidity, disinfection, equipment), etc. I took a particular interest in the breeding and research concerning disease control.

15. Bivoltine silkworm strains and their hybrids produced by the Research Centres are numerous and, in most cases, show yield caracteristics that are akin to (or slightly better than) those mentioned above. It will be difficult to get better results because these strains are almost level with the performances of the bivoltine produced elsewhere in the world.

16. However, these performances were not systematically selected under unfavourable climatic conditions (in particular under high temperature conditions) and, as they are all derived from bivoltine strains initially selected in temperate countries, they have the same characteristics : very good performances under 'non-tropical' climatic conditions (provided, of course, that one uses a suitable technology) and very strong susceptibility to diseases especially when the rearings are carried out at high temperature.

In view of all this, the breeding strategy must be revised if one want to produce bivoltine silk in areas and seasons when temperature is very high.

17. Moreover, few quality checks (or incomplete checks) on the raw silk obtained for these lines are carried out. At present, breeding takes essentially into account the quantitative and not the qualitative characteristics of bivoltine strains.

18. An important research effort has been placed in the study of diseases. Two types of studies are in progress:

- epidemiological studies, which tend to determined, by recording the data at farmers', the type of disease (pebrine, flacherie, grasserie...) and its extent in relation to areas and seasons. The result of this work will be invaluable in the future for establishing bivoltine cocoon production on more rational bases.
- studies which tend to work out early immunological detection tests of the diseases in the rearings at farmers'

In my opinion, these tests will only be useful for experimentation and at grainage level and not detection in young larvae (Chawki silkworms) in terms of production. These tests, which are indeed very susceptible, require only a few worms and, in any case, that the farmer may be able to test a large portion of the worms bred is completely out of the question. Hence the fact that no disease has been detected on the sample collected will not mean that there is no diseased worm. In addition, if grasserie or a bacterium are detected in the sample, what will be decided to control the disease ? It will be impossible to sort out the healthy worms from the diseased ones (except if one tests all the worms !), will it be necessary to eliminate the whole rearing ?

19. The biotechnological research conducted at CSRTI of Mysore, which deals with the study of the genome of *Bombyx mori* (molecular gene mapping) focused on the genes which govern disease resistance, is very interesting. The objective is to obtain eventually through gene transfer high-yield races in terms of productivity (and of quality) and of disease resistance.

However, it must be said that it will take very long for this research to come to something exploitable in the field, especially with the means implemented (the number of qualified researchers in this domain is quite insufficient). This was planned with the project of the Institute 'Scribiotech'. Unfortunately this programme is now behind schedule.

For this reason, classical breeding should not be discarded.

The interaction between these two types of complementary research can only be beneficial and expedite the production of new races.

Grainage. Seed production

20. Most of the seed production centres I visited in Karnataka, West Bengal and Tamil Nadu are well equipped. Some even have quite extraordinary equipments in terms of capacity and quality (I particularly think of the Government Model Grainage of Channapatna, Karnataka). I wish, however, to draw attention to two important weak points.

21. Seeds are produced and supplied in the form of layings stuck to the cards. The eggs are not removed from the cards, allowing for very rare exceptions. It follows what we have already pointed out, that is to say outright imprecision as to the number of eggs actually supplied. The removed eggs obviously enable this number to be determined very easily, by weighing them. But the other interest of removing the eggs from the sheets lies in the fact it permits the elimination of the defective eggs. This technique, commonly used throughout the world, consists in placing the bulk of the eggs in a saline solution of a given density in order to recover the densest eggs (which settle on the bottom) using gravity (settling and decanting) and to eliminate those that float or stay in an intermediary zone. The latter will not hatch or will give defective eggs. This enables the exact number of eggs supplied to be known and a very high hatchability of about 98 % to be guaranteed.

22. The second weak point concerns pebrine control on female silkmoths (Pasteur's cellular seed selection method).

This control is performed on only 25 % of hybrid or CB eggs. This is due to the fact that observations are made on each female individually and, as the number of layings is too large at this stage of the seed selection, the labour force cannot check all the female silkmoths.

This is all the more absurd since, when a female is known to be a pebrine spore carrier, all the layings of the corresponding batch are discarded. What then is the use of individidual detection and cellular seed selection ? In fact two strategies are possible : individual check of each female and elimination of the contaminated layings only (eliminating all the others is not justified). But this seems difficult, or even impossible, as only 25 % of the females can be checked.

The alternative, which is commonly used in Japan, China and Europe, is to pool the females of the same sheet of layings (20 in India) and to perfonn a check on the homogenate of these pooled 20 females. If pebrine spores are observed, the corresponding sheet is eliminated. In this way, time is saved and 100 % of the sheets are checked.

However, the spore detection conditions need considerable improvement.

23. In fact, apart from one exception, I could note that the pebrine checks in grainages were not reliable. Firstly because the homogenates are not filtered then centrifuged for concentrating the spores possibly present. Secondly because no background or specific spore staining is used for microscopic examination. The use of stains would considerably reduce the risks of errors, all the more as the staff who carries out the checks did not always seem very well trained to me.

24. In general the production of silkmoths for grainage centres is not suitable either. But this is related to the rearing conditions met among the farmers who produce seed cocoons. We will come back to this point in detail.

To summarize, I could note that only a few well-equipped and well-trained farmers (who obtained good yields) can be considered as good-quality cocoon suppliers. But this is not the general case, and cocoons from poor rearings (hence probably unreliable on the sanitary level) are used for seed production (the price of seed cocoons is so attractive that everyone wants to do that kind of rearing). In addition, incubation and Chawk rearing are, in most of the cases, performed by farmers who have no facilities to do them. I even saw seed cocoon production rearings in the villages (most unfavourable sanitary conditions owing to traffic, dust, etc.) and in rooms that were not isolated of the living quarters.

The alterations to be brought to the grainages (technically and organizationally) are not only valid for bivoltine seeds but also for CB's.

25. The cold storage conditions of bivoltine seeds are good, at least in the places I could visit. The hibernation programme generally used is modeled on the Japanese technique. However, I could note, in Tamil Nadu, that after experimenting a much simpler hibernation programme was adopted (after summer dormancy, 90 to 120 days at 5° C) which gives good results. This procedure is often used in Europe. I therefore think that it is possible to simply the technique generally used.

Commercial rearing

26. The yields in bivoltine hybrids rearing in the farms are very low in view of the potential of the races used. Let's take for instance the statistics of Karnataka (DOS) for 1990-91 the average yield is 30 kg/100 DFL's. The observations I made during my visits has shown me, however, that this was very heterogenous. A small amount of farmers obtain equal or superior to 55 kg, as is the case, for instance, in West Bengal (in the Banguria District of Nadia) where they obtained a mean production, for March-April 1990 rearings, of 76.2 kg for Pure NB4D2 (seeds from Mysore), of 52.2 kg for hybrid NB18 x NB7 (NSSP Orissa) in September 1990, and in 1989 they obtained 85 kg with hybrid KA x NB4D2 for seasons which are not particularly favourable. We will come back to this District later for other reasons.

However, the majority of bivoltine hybrid rearings give yields that are inferior to 35 kg.

For CB's, the yields are not extraordinary either. If one compares with the statistics of Karnataka for the same period 1990-91, the mean is 34 kg/100 DFL's, viz. only 13 % more than the bivoltines.

27. It is also well-known that yields differ considerably according to seasons and zones.

The answer I was given almost everywhere is that during the favourable seasons, the significantly higher yields were indentical for Bi x Bi and Multi x Bi

28. My observations on the fields have led me to attribute about 40 % of the reduction in the yield among farmers (as compared to the potential) to the feeding.

This can be easily measured by using the single cocoon weight as a parameter. It is generally inferior to the potential by 30 %.

29. It may have to do with the quality of the mulberry leaf supplied. CSB and DOS's lay much emphasis on this aspect. There certainly are many gardens that are not composed of the best mulberry varieties (S54, S1, etc.), the input of water and manure is not performed according to the recommendations of the Research Centres either, lastly pruning is not always carried out correcly and does not allow good leaves suitable to Chawki rearing or mature leaves for fifth instar silkworms in due course.

However, I could note throughout my visits that, on the whole, the mulberries were well maintained and that the leaves were good quality, or even very good quality, as far as one can judge by usual tactile criteria. This is true for the three States visited and it appears that the use of the best varieties perfected in the various Research Centres is more and more common.

30. Inversely, it was obvious for me that the quantity of leaves fed to fifth instar larvae was notoriously insufficient. Shortly after feeding, the silkworms starve for several hours. This is partly due to the habit taken with multivoltine races which eat less, but also the use of bamboo trays, the depths of which are insufficient and limit the quantity of leaves that can be deposited on the larvae.

In two instances, I observed rearings carried out on rectangular horizontal trays (2 and 3 shelves) that were very long (10 m) made up of nets mounted on wire stands and the depths of which were substantial. Furthermore, this technique, commonly used in Europe, is in either case associated with shoot feeding and not detached leaves. In either case, the yields are good. Shoot feeding shows other advantages.

31. The remaining 60 % yield losses are due to the fact that only a small amount of larvae brushed reaches the end of the cycle and gives cocoons. According to my estimates, on average 40 to 50 % of incubated eggs give cocoons.

This considerable loss is due to two causes, the relative quantity of which I cannot assess, as no check has apparently been carried out in the farms to measure the number of silkworms lost at each stage, nor to determine the reasons. This should fall into the work of the TSC's.

32. One of the obvious causes is the occurrence of a disease.

I could note in particular the presence of grasserie and of silkworms infested by the uzi fly. In rarer instances I detected pebrine and flacherie. But this can vary according to seasons.

In most of the farms, the sanitary conditions are not suited to this type of rearing. The rearing rooms are not always isolated from other activities and are even sometimes in the living quarters. This makes formalin disinfection virtually impossible.

Some rearings are located in the centres of the villages with openings (doors and windows) that look out directly onto the outside (no screen). Owing to this, the rearing rooms are not always very clean and dusts (which are germ carrier) are found in too large quantities.

Lastly, the use of bamboo trays is not, in my opinion, suited because it is impossible to obtain a thorough disinfection of these trays, even with formalin.

I visited farms which are very well equipped : construction of isolated rearing houses, outside the villages with perfectly smooth walls, ceilings and floors, easy to keep clean and to disinfect, openings kept tightly shut and proof to the uzi fly, screen rooms between the outside and the rearing room, etc. The results are of course significantly better since they increase from 25 kg/100 DFL's to reach yields as high as 50 kg/100 DFL's. This was what I noted in Karnataka (in Iraganahalli, at a new rearer's who uses bough feeding, in Ajjarvara in a Chawki rearing centre), West Bengal (Banguria, Nadia District) where farmers who started practising sericulture only a few years ago, have been installed in excellent conditions by the Government and immediately set to the suited technology under the supervision of CSB. In Tamil Nadu also, I visited a farm near Salem which produced Chawki worms as well as

rearing silkworms for commercial production ; this farm was very well equipped : recent building, absolutely proof to flies, isolated and very easy to disinfect and to keep clean, moreover wood trays had replaced the bamboo trays.

The general situation remains, however, very poor especially in the traditional sericulture areas.

33. In addition, I could note in many farms that diseased (in particular affected by grasserie) silkworms were left in the clays until the end. It seems that some farmers are not able to recognize diseases and cannot, therefore, discard systemically and regularly the diseased larvae. This increases the extent of the infection. Continuous field training (outside training courses) does not seem sufficient.

34. The second cause of the silkworm loss during rearing is the litter-cleaning. It is clear that the litter-cleaning using a net is not regular. For young worms in particular (first and second instars), the possibility that a significant number remains in the litters is not negligible. Given that the rearings, in most of the cases, starts with the eggs and not with the silkworms previously reared in Chawki rearing centres, this phenomenon can be relatively important.

35. However, the data concerning the loss of silkworms during the rearings have not apparently been recorded in the farms and one can only speculate on the importance of the various causes. This falls within the competence of TSC's. My feeling is that, however, the most important losses due to litter-cleaning occur during the first three larval instars and that the losses due to diseases are rather effective during the fourth and fifth instars. However the losses due to grasserie, flacherie or pebrine are caused most of the time by infections which start in earlier stages.

36. In India cocooning is systemically done on bamboo-made spiral-type mountages called Chandrika. They seem quite convenient to me provided that the density of larvae fit for cocoon spinning placed on the Chandrikas are in accordance with the recommendations. It sometimes appears that Chandrikas are overloaded. Deplacing the Chandrikas should also be avoided during spinning because this may lead to disruptions of the filament, hence, a higher number of breaks when reeling, or to incomplete spinning, hence, shorter filaments.

Chawki rearing

37. The young silkworm larvae are called Chawki in India. Their rearing, which starts with the incubation of the eggs and the hatching, is an important stage for silk production because in the first three instars silkworms are more susceptible to climatic conditions, viruses and bacteria which develop in the later stages.

This is why this rearing period, for bivoltine strains in particular (but this is also true for other races), should be conducted under flawless conditions (building, temperature, humidity, equipment, disinfection, most qualified labour, young mulberry leaves, etc.).

38. The use of Chawki rearing centres (CRC) was recommended in the previous reports of NSP. We have no choice but to note that this concerns only a small part of the bivoltine production. Most of the time, the incubation of eggs, hatching and rearing of Chawki worms are carried out directly in the farms under the conditions I have described above.

When the Chawki rearing is conducted separately, it is not always carried out in the right centres but in farms that are reportedly selected. Yet, I could note that some Chawki rearings were conducted in farms that do not have the required facilities (separate rearing rooms, outside the village, etc.). In any case, I saw only one farmer who had a suitable building for egg incubation. What is the point in the grainage centres supplying healthy eggs (at least disinfected with 2 % formalin) if these eggs are subsequently incubated under insalubrious conditions ?

39. Opinion is much divided among farmers as to the usefulness of separate Chawki rearing and supply of young worms instead of eggs.

Some think that it has hardly or no effect, of about 3 to 4 kg/100 DFL's. The farmers who held this view had yields of about 25 kg. At this level it is clear that Chawki rearing is not the deciding factor in the losses.

Other farmers, as those I met near Salem (TN), inversely prefer to buy third instar larvae to private Chawki rearing centres. For the price (50 Rs/100 DFL's) and given the amount of work it represents as well as a better reliability of the crops (according to them) they find it interesting.

40. However, I have been informed of only one objective study conducted on the field and checked by CSR & TI of Berhampore.

This study shows that on the same seed batches (different races), supplied directly to the farmers or after hatching and Chawki rearing in a suitable centre, the difference in the cocoon yield when harvesting is about 38 % and the difference in the silk ratio about 20 %, with the advantage for the worms reared through the Chawki rearing centre.

41. Anyway, this study is useful for showing that in India things are the same as elsewhere in the world. The supply of young silkworms to the farmers after rearing the Chawki in a specialized centre always gives far better results. This is true for bivoltine hybrids but also for CB's and for the seed production of pure races.

Reeling.

42. The reelers I have met almost all possessed multiend reeling machines. These machines are often very recent and well designed. None of them has a denier control mechanism. They are also equipped with re-reeling machines and often twisting. However the majority of the reelers reel the cocoons on Charka.

43. The labour working on these machines seems well trained. However, in a few instances, I noted some faults, in particular in recycling the cocoons. There could be less waste.

44. The boiling of cocoons is often done in basins in which the water is steam heated, which is fine, but the cooking temperature is not really checked.

45. All the various types of cocoons are reeled on multiends : CB's, bivoltine hybrids and even pure race bivoltines. I did not see any reeling of dried cocoons, generally reeling is done on fresh cocoons.

46. The reelers do not really know the grade of the raw silk produced in their factories. I could not find out how and by whom the grading was done after the reeling. I think that the grading is not carried out systematically. Two of the reelers have maintained that they obtained grade A with bivoltine (hybrid) cocoons or with pure races. Given the reeling speed, the absence of denier control and boiling method, I am surprised that grade A can be obtained with 20-22 denier thread, at least, on a constant basis.

47. Apparently, the grade of the raw silk obtained (quality) is not the chief concern. Only the basin yield (renditta) concern the reelers. This is due to the fact their production is essentially intended for handlooms.

48. It explains the fact that they do not wish to pay for the bivoltine cocoons more than the others because they assert that renditas are not better of even inferior to that of CB's.

This is contradicting the comparative tests carried out at CSR & TI of Bangalore (see Table III).

I personally think that this is due to the fact that the technology is not suited to the reeling of bivoltine cocoons because quality silk is not the essential goal of the reelers who do not seems to have a market for selling such a raw silk.

Areas - Seasons

49. The rearing of existing bivoltine races and hybrids idcally requires temperature conditions in the fourth and especially in the fifth instars of about 22 to 25°C. Under these conditions, bivoltine silkworms give the best performances owing to their metabolism, but also because under these temperatures, the risks of viral and microbial spreads are limited.

These races are more susceptible than multivoltine to viruses and bacteria, irrespective of the temperature conditions but diseases develop better under high temperature and humidity, the difference in the resistance between the two types of silkworms is actually perceptible only under these conditions.

50. Such conditions are rare in India since the farmers do not have the means to air-condition the rearing rooms and I do not think that it would be realistic to enter into this line.

There exist, however, areas and seasons which give these conditions. I know that it is the case for the temperate zone of Jammu and Kashmir, but also in the southern States. I could note, for instance, that in Servorayam Hills (Tamil Nadu), the conditions were perfect. In the middle of August, the rearing houses need heating at night.

51. Outside these ideal zones, it is possible to find favourable conditions in Karnataka, West Bengal and Tamil Nadu, particularly in winter and in some high altitude places during other periods.

52. I could note that all the executives of CSB and DOS's were very well acquainted with the most favourable zones and seasons for bivoltine cocoon production. I think that from this angle, things are well identified.

Conclusions.

53. A large part of the conclusions and recommendations I can draw from my mission have already been taken into account in the consolidated bivoltine action plan. However, we have no choice but to note that in the field, the operation does not always meet with the expected success.

54. On the general technical plane, the principal reason, in my opinion, is wanting to replace traditional sericulture by bivoltine sericulture. Given the objectives, to increase bivoltine production to compete with good-quality raw silk imports, bivoltine production must absolutely be added to the existing sericulture without trying to replace traditional production. The latter has its own home market which works well and is intended for handlooms. An new entire channel must, therefore, be created in addition to the existing one for the bivoltine silk intended for powerlooms. Of course, the CB production can itself be improved, particularly in terms of productivity, by securing a better implementation of the rearings technically and by improving the equipments and the material of the farmers. A fair number of recommendations which are made for bivoltine production should also be applied to CB's.

56. By wanting to thrust bivoltine production on to farmers who were not ready for it, the results of the yields were disastrous and gave a bad image of bivoltine silkworms.

Although almost all of the technology for producing good-quality bivoltine raw silk is known in India as far as the research centres, it could not be implemented in the existing situation, essentially because traditional farmers cannot change their habits easily (rearings in all seasons, insufficient feeding, irregular checks) not to mention their material means (high-yield mulberries, manure, irrigation, sanitary protection, separate rearing rooms, off-village zones, etc.).

In the present channel, technology is available but facilities and technology transfer are not avaible at field level.

57. This situation is worsened by the fact that the demand for bivoltine cocoons by the reelers is low. The purchase price of bivoltine cocoons is thus inferior to that of Multi x Bi cocoons. Lower yields and lower selling prices for the farmers can but discourage the producers.

58. If the demand from the reelers is low it is because they do not need to produce high-quality raw silk and they generally sell all the silk produced for handlooms. As the reeling of bivoltine cocoons, given the technology used, does not give better yields than the reeling of CB's, the reelers do not need bivoltine cocoons.

59. It also means that there is no pressure on the part of the weavers (who at present import Chinese silk and possess modern power-looms) on the reelers to obtain this high-quality raw silk. Why is that ? Because they do not trust them or because the price to be paid for making the work of the farmers and that of the reelers cost-effective is too high ?

60. If so, we have broached a crucial point of the programme.

I have a feeling that this aspect has not been sufficiently analyzed when NSP and the Bivoltine Action Plan have been set up. If, indeed, it was asserted that the bivoltine silk produced in India was aimed at reducing raw silk imports, one cannot find anywhere an analysis of the conditions under which the weavers are willing to buy Indian silk. Everything was conceived in relation to sericulture in order to improve production and quality but not in relation to the economic conditions of the market. It is, however, easy enough, or so it seems to me, to know nowadays at what price grade A or 2A raw silk can be sold to the weavers for a correct remuneration of the reelers and farmers (the bivoltine cocoon should be charged much more than the CB cocoon). Under these conditions, what do the weavers think ?

If they prefer, under free market conditions, to use imported silk, it is pointless to pursue the NSP's Action Plan. History showed that sericulture in Europe disappeared because the weavers found cheaper silk in the East whereas Italy and France produced excellent quality raw silk.

If, in spite of this, one wants to produce bivoltine silk A, 2A, 3A..., it becomes a political problem, the consequences of which should be drawn. In any case, it is urgent to bring together all the various parties in order to clarify the situation.

61. I think that, owing to this situation of field technical failure associated with an unclear market situation for bivoltine silk, a certain sullenness can be felt among the persons in charge of the project (CSB, DOS, Institutes...) as well as a certain wait-and-see behaviour in relation to the bivoltine programme.

I could indeed note that no one, either individually or collectively, was really urging with enthusiasm and determination on the development of bivoltine production.

This state of mind should be broken by settling the problem of the outlet of high quality raw silk in India (quantity, price) as soon as possible and in a clear manner. By settling the problem downstream the situation upstream (reeling, sericulture) will change and develop (or remain as it is, depending on the conclusions).

Recommendations

On the general plane

1. Bivoltine production should be limited (with the existing races) very strictly to the best areas and seaons. Even if only two or three crops are possible in some cases. Rearings should not be conducted outside these conditions.

2. Seed cocoon and hybrid cocoon production should be very strictly limited to the best farmers (the most individually able, the best equipped in mulberries and buildings, in materials, those who have the best yields). All the other farmers should be discarded from the bivoltine channel so that they may devote themselves entirely to seed cocoon for grainage of CB's (solely) and to commercial production of CB's.

It is necessary to take an uncompromising line and issue particular and very selective licences for bivoltine production (pure races intended for Bi x Bi grainage and Bi x Bi hybrids).

3. In this new independent channel the new sericulturists should be included. They should be given straightaway the support required for suitable equipment and technology. Provided of course that they are in favourable present or new areas.

4. The same should be done for Chawki rearing, grainages, reeling factories. The best should be selected after checking the performances and licences for bivoltines should be given only after these checks have been performed.

5. The idea behind all this is, as I have already said, that a new complete channel that would be independent from the rest should be created for bivoltine silk.

The fact of authorizing (through the creation of a licence, a contract or a label as well as a precise schedule of conditions) only the very best of the producers to do bivoltine production not only to improve objectively the results but also to change the behaviour towards bivoltine silk.

Its image will grow in stature.

On the technical plane.

A. Grainage. Seed production.

1. The grainage technique needs to be modified so that loose eggs may be distributed. These eggs should have previously been screened through settling and decanting. In this way, one can know their exact number expressed in 'boxes' and not in weight as the weight can vary from one race to the other.

2. Pebrine detection must also be considerably improved by checking 100 % of layings. To this end, the method I have explained should be applied (pooling 20 females of the same sheet).

The microscopic examination of the spores must also be improved by using systematically filtering and centrifugation of homogenates of females and by using background or specific stains for observation.

3. The grainage centres for bivoltines should not produce CB seeds and, hence, should not use multivoltine silkmoths. They should only produce Bi x Bi seeds and pure bivoltine races.

4. These grainage centres must also control the seed cocoon producers and issue the licences according to the criteria already defined. No compromise on the quality. If it is possible the socio-economic organization of India, it would be better if the collection of the cocoons was done by the grainage centres in the farms and no longer through the markets.

5. The grainage centres existing or to be created can be private or official but must all be labelled as per a precise schedule of conditions.

B. Rearing

1. Chawki rearing must be systematic whether it be for seed cocoons or bivoltine hybrids. This could also be applied for CB's.

2. Chawki rearing centres, private or official, must be specially designed for this :

- off village areas ;
- perfectly equipped building for disinfection, cleaning and airing, (air-conditioning should even be considered) and absolutely proof to insects ;
- specific Chawki garden with the recommended mulberry varieties and technologies.
- most qualified staff, specially trained for this type of rearing.
- the capacity of the Chawki rearing centres (surface and number of people) must be suited to the number and capacity of the farmers concerned. I obviously recommend that the farmers be rather close to the CRC (less than one hour of transport of the worms).

3. The worms should be distributed to the farmers after the third molt (in the fourth instar) and not after the second molt as is the case at present.

4. The bamboo trays should be gradually replaced in the selected farms (or installed straightaway in the new farms) by wood or plastic clays (in large numbers the cost can be very low).

5. Shelf rearing should be promoted in the new farms. This takes more room and is therefore easier to implement when equipping new rearing houses.

6. Shoot feeding should be promoted along with these horizontal trays (2 to 3 shelves). This technique gives good sanitary conditions (more spacing between the worms and between the worms, the litter and their dejecta) and saves a lot of labour time.

7. As for the rest of the rearing technology, recommendations are the same as those indicated elsewhere, and only the farmers who comply with these recommendations should be licensed to produce bivoltine cocoons :

- separate rearing rooms outside the village ;
- disinfection facilities between each rearing ;
- bottom openings to allow fresh air and top openings for the draining of hot air. Partial control of the temperature. These openings should be fly-proof ;
- lock room between the outside and the rearing room (to be provided when installing new farmers) ;
- use of disinfectants and nets for bed-cleaning. Frequent bed-cleanings ;
- quantity and quality of the food ;
- good management of the mulberry gardens, with high-performance varieties ;
- etc.

C. Post-cocoon harvest.

1. It is essential to have, in the nearest future, a gradation of the silk produced by the various reelers and with the various reeling machines (multiends, semi-automatic, automatic, with or without denier control). This can probably be done by CSTRI (CSB) at first. Then when the channel is operating, this can be done by specialized (private centres) which will give thier results to the seller (reeler) and to the buyer (weaver).

2. The reeling of bivoltine cocoons should be allowed only to those who obtain at least grade A on a regular basis.

3. The best, in my opinion, would be to direct all the bivoltine cocoons towards the Japanese automatic reeling machines which exist in India. Only under these conditions will grade A, 2A or maybe 3A definitely be produced. This would make the existing automatic machines profitable, enable actual 2A to be obained and confirm the particular character of the channel (added to the traditional independent channel) for bivoltine silk intended for power-looms. The other reelers with good machines and CB's can certainly produce grade C or B and in any case would continue to direct their production towards handlooms.

4. Further attention should be given to what is wrong with the quality of the doupion silk (which I was enable to do) since a large quantity of doupion silk is imported. I think that the Chinese actually supply false doupion obtained by reeling defective or flimsy cocoons on a normal reeling machine (to be looked into).

5. Given the organization of the bivoltine channel and of the low number of crops during a short period, drying and dry cocoon stocking facilities have to be provided so that reeling machines may be fed regularly all the year round. This is virtually inexistant today. Support should be given for buying the corresponding machines (from Japan) if this done by private deelers and make adequate use of the recommended techniques. The drying of cocoons is an important stage in avoiding to deteriorate the quality of the silk.

6. It is also most important to improve the cocoon boiling conditions, especially if dry cocoons are used. Here again, there are in Japan machines (of all sizes) which enable temperature to be regulated and the various stages to be scheduled (in fact boiling or cooking is done in stages at different temperatures for precise lengths of time). This aspect also must be fully revised in India, at least in the three States I visited.

On the research plane.

1. The breeding research should be re-oriented in order to obtain real new strains. Up until now, the races produced have been selected for their productivity (and sometimes for their quality) but without allowing for the fact they were not suited to the tropical climatic conditions.

The existing races really give good performances only if they are reared in the fifth instar at 22-24°C (as is the case in Japan, Europe and China). It is therefore essential, from the already isolated races (there are probably over 20 if one puts together those of CSR & TI of Mysore, of CSR & TI of Berhampore and of KSSDI), to obtain new races by putting a selection pressure on the climatic conditions, in particular under high temperature conditions (without forgetting to allow for the quality of the raw silk). It is possible a result within 10 generations (5 years). Other races can also be introduced from elsewhere. I have already supplied French races and I will give some more to Dr Datta in September. However, there is no reason for them to be well adapted to tropical conditions.

The new races will not, of course, give as good performances quantitatively as the existing ones under normal conditions (although it is possible) but will be far better under the conditions usually met with in India.

2. The breeding should also allow for the study of genetics of the characters related to the quality of the silk (neatness in particular) in order to know the heritability of these characters.

3. I recommend that a breeding programme be worked out among the various institutes to obtain coordination and co-operation and not duplication of the work. It is essential to restrict the programme to a small number of races at first and retain only those which behave best under high temperature condistions (30°C at least) during the first screening. Then their performances will habe to be improved under the same conditions for the survival rate, cocoon wieght, silk percentage, quality, fecundity, etc. Furthermore, I suggest that with the existing races and hybrids the performances of polyhybrids be assessed.

5. The research on the detection and control of silkworm diseases must be pursued both as far as epidemiology is concerned and as regards the working out of immune detection tests. These test will mainly be useful at grainage level. The working out of new control means (chemicals, biological control) against infections and pests must be pursued and supported.

6. The biotechnological part (molecular genetics) is very important as regards its contents. But it can be carried out only over a long period of time given the extent of the work and the means required.

One must stick to the course of the genes responsible for the diseases and not extend the field of investigation to other problems.

It is essential to build up co-operations with laboratories that already work on these genes in other insects. This will enable the programme to be considerably speeded up, for instance by using as molecular probes genes already isolated elsewhere. These co-operations may help to find partners interested in ensuring part of the work.

But I emphasize again the fact that it is a long-term work (10 years at least) if one wants to produce disease-resistant and high-yield strains through this method. This is due to the fact that we do not know how many genes are involved, or which and what differences exist between strains. In fact, I recommend the continuation of this programme especially because, through traditional genetics and breeding, even by carrying out the selections proposed, the best yields and resistance are unlikely to be obtained in the same races under unfavourable conditions. There will be an improvement but everything will not be maximal.

7. The research concerning the development of rearing units and/or Chawki rearing in the farms which do not have separate rearing rooms undertaken at KSSDI seems very interesting to me. It could enable productivity to be improved among the poorest farmers, even if it is for producing CB cocoons.

8. As regards the mulberry, the existence of many high-performance varieties worked out at Berhampore and KSSDI in particular leads me to think that the efforts should rather be placed on the pathology and physiology of these varieties.

All these points are, in my opinion, more important than the rest of the research in progress in the various institutes.

Extension

1. The trainings taken up over one-month periods are very useful for training the farmers. The training of beginners must be separated from that of the people who already have a sericultural experience.

2. The chief problem is, I think, continuous field training. One can note that among farmers, a number of very useful things are not known (detection of the diseased worms, recognition of a disease, etc.). This is probably due to the inadequate number of persons in the TSC for the number of farmers but maybe also the qualification of the executives. For instance in Tamil Nadu the executives are only graduates. It is essentially to see to the training of the TSC.

3. In addition, TSC's should not only advise the farmers but in return should give useful information and not only for production statistics. For instance, what are the losses (in number of silkworms) in each instar in the farms ?

4. Nevertheless, I find it very positive that the training structures and TSC exist. They only need to be strengthened and their efforts to be focused on the farmers who will be involved in the bivoltine programme.

Technical assistance.

Technical assistance is required in the following domains, through training periods of adequate durations abroad.

1. Grainage in Japan.

2. Post-cocoon harvest technology.
- Reeling (Japan and France).
- Drying (and storage of dried cocoons) (Japan and China).
- Cooking, boiling (Japan and China).

3. Chawki rearing centre in Japan and in Italy. A certain amount of people should be sent to Japan, preferably in the Chawki rearing centres feeding silkworms with mulberry leaves (and not with artificial diet).

4. Scientifically the programme in progress with the Japanese (JARQ) seems useful to me for the breeding methods. However, according to the Japanese, their work would especially be to show and advise but not to produce new races.

5. Inversely, in the field of genetic engineering, it is desirable to send researchers to Europe, the USA and Japan in various laboratories specialized in the study of insect-immune genes.

I offer to introduce Dr Datta to some of these laboratories during the 2nd International Workshop on the Molecular Biology and Molecular Genetics of Lepidoptera which will be held next September in Greece.

6. The introduction of new bivoltine and even multivoltine races can be benefitial for working out new formulae. However, there is no miracle to be expected : European, Japanese and Chinese (difficult to obtain) bivoltine strains will not give better performances under the Indian climatic conditions.

I will make a request (with little hope) to the Japanese, I expect more success with the Italians and with Madagascar (for multivoltines).

APPENDIX TABLE I

Race	Eggs/Laying	Hatching %
$NB_7 \times NB_{18}$*	463	91.77
$NB_{18} \times NB_7$*	585	96.76
$NB_7 \times NB_{18}$*	551	96.80
$NB_4D_2 \times NB_7$*	583	95.40
$NB_{18} \times KA$*	599	96.74
CB		
$RD_1 \times NB_{18}$	493	82.5
$P_2D_1 \times NB_{18}$	520	80.7
$PA_{11} \times NB_{18}$	502	80.9
$K_{101} \times NB_{18}$	496	78.6
MY1 x NB18	449	76.9
PM x NB_{18}	408	79.5

Average eggs/laying and hatching % obtained in different hybrids in the CSR & TI of Mysore.

* Bivoltine hybrids rearing conducted under bivoltine training programme for NSP/DOS official from April 1990 to March 199· Compiling several other results the extreme values obtained for the number of eggs by laying are ; minimum 300 , maximum 750 Most of the values are located between 400 and 650.

APPENDIX : TABLE II.

Average yield of different races (hybrids bivoltine and Cross Breed) obtained at CSR & TI of Mysore.

Race	No.of DIIs	Total yield in kg	Yield/10000 larvae brushed (kg)	Cocoon Wt gm	Shell ratio %
Bi x Bi					
NB_7 xNB_{18}	105	73.67	17.66	1.97	20.5
NB_{18} x NB_7	100	98.70	17.40	1.92	20.3
NB_7 x NB_{18}	125	89.55	13.33	1.78	19.4
NB_4D_2 x NB_7	150	143.75	16.88	1.93	19.2
NB_{18} x KA	110	89.38	13.97	1.73	20.1
C B.					
RD_1 x NB_{18}			14.66	1.62	17.18
P_2D_1 x NB_{18}			15.88	1.78	18.72
PA_{11} x NB_{18}			15.52	1.78	18.28
K_{101} x NB_{18}			14.96	1.81	18.35
MY x NB_{18}			15.18	1.72	17.71
PM x NB_{18}			14.01	1.64	17.53

APPENDIX : TABLE III

Standards reeling performance of multivoltine and bivoltine cocoons (CSTRI multiend reeling machine)

	Bivoltine	Multivoltine
Single cocoon weight (g)	1.59	1.63
Single shell weight (g)	0.318	0.27
Shell ratio %	19.8	16.6
Ave. filament length (m)	822	696
Ave. non-breakable filament length (m)	673	497
Single cocoon filament denier	2.52	2.43
Renditta	8.4	9.3
Raw silk recovery (%)	60.4	64.5
Waste (%) on silk weight	26.7	31.0

APPENDIX TABLE IV

Test reeling performance of bivoltine cocoons supplied by DOS, Government of Karnataka, reeled on CSTRI improved multiend reeling machine.

	NB4D2 x KA	KA x NB4D2	NB7 x NB18	NB4D2	KA	NB7
Single cocoon weight	1.16	1.39	1.19	1.28	1.42	1.28
Single shell weight	0.18	0.23	0.18	0.18	0.24	0.20
Shell ratio (%)	16.04	16.64	15.66	14.51	16.76	16.02
Av. filament length	702	703	682	625	749	884
Av. non-breakable filament length	585	612	593	543	576	655
Av. single cocoon filament denier	1.93	2.06	1.86	2.13	1.97	2.23
Renditta	10.9	10.9	12.2	13.5	14.0	13.3
Raw silk %	57.1	55.0	52.3	50.9	42.8	46.8
Waste (% on silk weight)	27.5	32.6	39.6	44.03	45.0	44.44

収集資料一覧表

1．中央蚕糸局（CSB）発行

＊SLKMAN' S COMPANION 1992

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