

sericologia

Journal of the silkworms.

Revue des vers à soie.

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COMMISSION SERICICOLE INTERNATIONALE

ACTES ET INFORMATIONS

Réunion du Bureau du Comité Exécutif de la C.S.I.

Le Bureau du Comité Exécutif s'est réuni à Lyon le 6 décembre 1984. Au cours de cette réunion, le projet d'amendement de la Convention institutive de la C.S.I. créant des Membres Associés, a été approuvé par les membres du Bureau du Comité Exécutif, après que les Chefs des Délégations des Etats Membres aient été consultés par correspondance. La Conférence réunie à Bangalore (Inde) le 26 mai 1984 avait par avance donné un accord de principe à la création de Membres Associés.

Projet d'amendement :

Art. 4.

Font partie de la Commission, les Etats Membres ayant ratifié la présente Convention ou y ayant adhéré. Chacun des délégués de ces Etats porte le titre de délégué national. Chaque Etat-Membre désigne un chef de délégation.

Art. 4 bis.

Les associations nationales ou internationales, les collectivités et les particuliers qualifiés, des Etats Membres et non-membres, dont les activités rejoignent celles de la Commission, peuvent, sur proposition du Secrétaire Général et par décision du Bureau du Comité Exécutif, être nommés "Membres Associés" de la Commission Séricicole Internationale.

Dans les conditions fixées par le Comité Exécutif, les "Membres Associés" :

- reçoivent les publications périodiques,
- peuvent consulter la documentation,
- peuvent prendre part aux travaux des Congrès et des réunions techniques et scientifiques,
- peuvent assister aux réunions de la Conférence de la Commission.

Art. 9.

Les "Membres Associés" assistant aux travaux de la Conférence, peuvent être, en raison de leur compétence, consultés par le Bureau de la Conférence mais ils n'ont pas le droit de vote.

Art. 22.

Les recettes de la Commission sont constituées par les participations financières des Etats Membres et par les contributions des "Membres Associés".

La participation financière des Etats est constituée par deux cotisations annuelles :

l'une, scientifique, basée sur le chiffre de la population,
l'autre, technique et économique, calculée au prorata de la production de cocons frais.

Le montant et les modalités de versement des contributions des "Membres Associés" sont fixés par le Comité Exécutif.

Membres Associés.

Dans le but de permettre à des personnalités ou à des organismes scientifiques ou techniques de prendre une plus grande part à l'action de la C.S.I., le Secrétaire Général propose la création de Membres Associés tels qu'ils existent déjà dans d'autres organisations.

Cette proposition a reçu l'approbation de la Conférence, du Comité Exécutif et du Bureau du Comité Exécutif.

Les Membres Associés remplaceront au sein de la Commission les Membres Observateurs prévus primitivement dans la Convention.

Les Membres Associés, comme prévu dans le projet d'amendement, recevront la revue SERICOLOGIA. L'annuaire international des Bacologues et des séricicologues, actuellement en préparation, sera réservé aux services administratifs des Etats Membres et aux Membres Associés.

A l'avenir, SERICOLOGIA sera distribué uniquement :

- aux services officiels des Etat Membres,
- aux Membres Associés,
- aux éditeurs en échange d'autres revues.

Il est demandé aux personnes qui reçoivent actuellement Sericologia et qui désirent continuer de le recevoir, de renvoyer le formulaire d'adhésion ci-joint.

INTERNATIONAL SERICULTURAL COMMISSION

RECORD AND INFORMATION

Meeting of the Executive Committee Board of I.S.C.

The Executive Committee Board met in Lyon on December 6, 1984. In the course of this meeting the draft amendment of the Convention instituting I.S.C. creating Associate Members was approved by the members of the Executive Committee Board. Heads of Member States Delegations had previously been consulted by letter. The Conference which took place in Bangalore (India) on May 26, 1984 had already agreed in principle on the creation of Associate Members.

Draft amendment :

Art. 4.

The Member States which have ratified the present Convention or have joined it become members of the Commission. Each one of the delegates of these States appoints its head of delegation.

Art. 4 bis.

National or international associations, collectivities or private individuals either from Member or non Member States, the activities of which are similar to those of the Commission, may, on proposal of the Secretary General and with the agreement of the Board of the Executive Committee, join the International Sericultural Commission as "Associate Members".

Within the conditions fixed by the Executive Committee, the "Associate Members" :

- receive the periodical publications,
- can consult the documents,
- can take part to the works of the Congress and of the technical and scientific meetings,
- can attend the meetings of the Commission Conference.

Art. 9.

The "Associate Members" attending the works of the Conference can be consulted on account of their competence by the Board of the Conference, however, they are not entitled to vote.

Art. 22.

The receipts of the Commission are issuing out of the financial participations of the Member States and of the contributions of the "Associate Members".

The financial participation of the States is made up of two annual subscriptions :

A scientific one, taking the population number as a basis,

A technical and economic one, calculated in proportion to the fresh cocoon production.

The amount and terms of payment of the contributions due by the "Associate Members" are determined by the Executive Committee.

Associate Members.

In order to enable personalities or scientific or technical organisations to take part more widely in the activities of I.S.C., the Secretary General suggested the creation of Associate Members as they already exist in other organizations.

This proposal was approved by the Conference, the Executive Committee and the Executive Committee Board.

Observer States will be replaced in the Convention by Associate Members.

As stipulated in the draft amendment, Associate Members will receive the journal SERICOLOGIA. The international directory of bacologists and sericologists, which is under preparation, will be reserved to Member States officials and Associate Members.

From now on SERICOLOGIA will exclusively be sent to :

- Member States officials,
- Associate Members,
- publishers in exchange for other reviews.

All those who presently receive Sericologia and wish to go on receiving it are begged to return the here enclosed membership form.

ERRATA

T. Anitha Sironmani and C. Selvanayagam

GENE EXPRESSION DURING DEVELOPMENT : STUDIES ON THE ROLE OF RIBONUCLEOPROTEIN PARTICLES IN FIBROIN SYNTHESIS.

Sericologia, 1984, 24(4), p. 491 and 492.

Further to some mistakes in the original manuscript, we beg you to take note of the corrections made by the authors in figure 6 (p. 491) and table 7 (p. 492). (cf. fly sheet here enclosed).

Nous vous prions de bien vouloir prendre note des corrections apportées par les auteurs à la figure 6 (p. 491) et au tableau 7 (p. 492), suite à des erreurs dans le manuscrit original. (cf. feuille volante ci-incluse).

R. Narayanaprakash, K. Periasamy and S. Radhakrishnan

STUDIES ON DOUBLE COCOON FORMATION IN TWO RACES OF BOMBYX MORI L. (LEPIDOPTERA : BOMBYCIDAE).

Sericologia, 1984, 24(2), p. 169.

Further to some mistakes in the original manuscript, we beg you to take note of the corrections made by the authors in table 1 (p. 169). (Cf. fly sheet here enclosed).

Nous vous prions de bien vouloir prendre note des corrections apportées par les auteurs au tableau 1 (p. 169), suite à des erreurs dans le manuscrit original (cf. feuille volante ci-incluse).

XIV^e CONGRES SERICICOLE INTERNATIONAL
XIVth INTERNATIONAL SERICULTURAL CONGRESS

*

SECTION NON-MURIER
NON-MULBERRY SECTION

*

Chairman : K. SENGUPTA

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CYTOLOGICAL STUDIES IN FOOD PLANTS OF TROPICAL TASAR SILKWORM
(A. MYLITTA)

ETUDES CYTOLOGIQUES CHEZ LES PLANTES NOURRICIERES DU VER A SOIE
TUSSAH (A. MYLITTA)

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The present work deals with the karyomorphology and meiotic behaviour in six species of *Terminalia* which are collected from different localities of Karnataka. Of these, the chromosome numbers of *T. paniculata*, Roth. ($2n = 24$), *T. bellerica*, Roxb. ($2n = 48$) and *T. chebula*, Retz. ($2n = 48$) are recorded here for the first time. The other species, namely, *T. arjuna*, W & A., *T. tomentosa*, W. & A., and *T. catappa*, Linn. reveal $2n = 24$ only. Karyomorphological details also have been furnished here in all the taxa for the first time. In general, the somatic chromosome complements consist mainly of long (more than $4 \mu\text{m}$) and medium (2 to $4 \mu\text{m}$) chromosomes. The taxa possess symmetrical karyotypes with either metacentric or submetracentric chromosomes. However, each species has its own karyotype regarding the position of centromere and arm ratio.

These cytological data suggest that polyploidy and structural alterations in chromosomes have played their role in the evolution of the genus *Terminalia*. Abnormalities have not been noticed in the meiotic division of these taxa.

Cette étude porte sur la caryomorphologie et le comportement méiotique chez six espèces de *Terminalia* provenant de différentes localités du Karnataka. Parmi ces espèces, le nombre de chromosomes a été déterminé pour la première fois chez *T. paniculata*, Roth. ($2n = 24$), *T. bellerica*, Roxb. ($2n = 48$) et chez *T. chebula*, Retz. ($2n = 48$). Chez les autres espèces, c'est à dire *T. arjuna*, W. & A., *T. tomentosa*, W. & A. et *T. catappa*, Linn., $2n = 24$ seulement. Cette étude donne également des détails caryomorphologiques, et ce pour la première fois, pour toutes les espèces. En règle générale, les chromosomes somatiques se composent de chromosomes longs (plus de $4 \mu\text{m}$) et moyens (2 à $4 \mu\text{m}$). Les caryotypes sont symétriques aussi bien pour les chromosomes métacentriques que pour les chromosomes submétacentriques. Cependant,

chaque espèce a son propre caryotype en ce qui concerne la position du centromère et le rapport des bras.

Ces données cytologiques suggèrent que les altérations polyploïdiques et structurelles des chromosomes ont joué un rôle dans l'évolution du genre *Terminalia*. Aucune anomalie n'a été décelée dans la division méiotique de ces espèces.

INTRODUCTION

The literature survey has revealed that the cytological studies in food plants of tasar silkworm are quite inadequate. Cytological informations are wanted in these economically important taxa for their selection and successful utilization in breeding experiments. The present cytological investigation records the chromosome number, karyomorphology and meiotic behaviour in six species of *Terminalia* occurring in Karnataka. These cytological data coupled with taxonomic characters have been discussed in this paper.

MATERIALS AND METHODS

Plants occurring in wild state were collected from different localities of Karnataka (Bannerghatta, Devarayanadurga, B.R. Hills, Agumbe and Sagar) and were grown in the Jnana Bharathi, Bangalore University Campus, Bangalore. For somatic chromosome studies excised root tips from young plants were pretreated with 8-hydroxyquinoline for 3-4 hours at 10°-12°, were fixed in acetic-alcohol (1:3) and were stained with Feulgen's. For meiotic studies, flower buds of suitable size were collected from the plants and fixed in acetic-alcohol between 9.30 and 11.30 a.m. Squashes were made in aceto-carmin (1.5%).

Photomicrographs were made from the semipermanent slides. Drawings were also made with a camera lucida at table level.

OBSERVATIONS

The somatic chromosomes are found to be relatively uniform in all the species investigated. The chromosomes are grouped into two categories, namely, long (more than 4 μ m) and medium (2 to 4 μ m). These are further classified into the following types on the basis of primary and secondary constrictions for the analysis of the karyotypes :

Types A^m and Asm - Long chromosomes (more than 4 μ m) with median and submedian primary constrictions respectively.

Types B^m and Bsm - Medium chromosomes (2 to 4 μ m) with median and submedian primary constrictions respectively.

T. catappa, Linn :

The somatic complement has $2n = 24$ (Fig. 1). Among them, ten pairs have nearly median centrometric constriction, while the remaining pairs have submedian centromeres. The chromosome length ranges from 2.54 μ m to 3.91 μ m. The total chromatin length of the haploid set is 37.81 μ m. The karyotype formula for this taxon is $2n = 24 = 20B^m + 4B^{sm}$.

Meiotic behaviour is normal. Twelve bivalents have been observed at diakinesis.

T. paniculata, Roth. :

This is the first cytological study made in this species. The somatic chromosome number is $2n = 24$ (Fig. 3). It reveals the long and medium type of chromosomes. There are six pairs of long chromosomes. Among them, four pairs have metacentric constrictions (A^{sm}). Even among six pairs of medium chromosomes, four pairs have metacentric constrictions (B^m) and two pairs have submetacentric constrictions (B^{sm}). The longest chromosome in the complement measures $5.50 \mu m$ and that of the shortest is $2.9 \mu m$. The total haploid chromatin length is $50 \mu m$. The karyotype formula for this species is $2n = 24 = 8A^m + 4A^{sm} + 8B^m + 4B^{sm}$.

Meiotic behaviour is regular.

T. tomentosa, W. & A. :

The somatic chromosome number is found to be $2n = 24$ (Fig. 4). The karyotype analysis reveals the presence of long and medium types of chromosomes. Among ten pairs of long chromosomes, seven pairs are with median primary constrictions (A^m) and the remaining three pairs possess submedian primary constrictions (A^{sm}). There are only two pairs of medium chromosomes with submedian primary constrictions (B^{sm}). The difference in the chromosome length ranges from $3.2 \mu m$ to $5.7 \mu m$. The total chromatin length of the haploid set is $50.7 \mu m$. The karyotype formula for this species is $2n = 24 = 14A^m + 6A^{sm} + 4B^{sm}$.

Meiotic behaviour is normal. The behaviour of chromosomes at anaphase-I is normal showing perfect disjunction and the distribution of equal number of chromosomes to the poles.

T. arjuna, W & A. :

As in the previous case, the somatic chromosomes number is $2n = 24$ (Fig. 2). Even here the chromosomes are relatively long. It reveals the presence of long to medium type of chromosomes. Among the long chromosomes, seven pairs have median centromeres (A^m) and two pairs have submedian centromeres (A^{sm}). Among the medium chromosomes, one pair has median centromeres (B^m) and the remaining two pairs have submedian centromeres (B^{sm}). The chromosome length ranges from $6.4 \mu m$ to $2.2 \mu m$. The total chromatin length of the haploid set is $53.9 \mu m$. The karyotype formula for this taxon is $2n = 24 = 14A^m + 4A^{sm} + 2B^m + 4B^{sm}$.

Meiotic behaviour is normal and shows the regular formation of twelve bivalents at metaphase I.

T. chebula, Retz. :

Cytology of this species has not been worked out previously. The chromosome number is $2n = 48$ (Fig. 5). The karyotype analysis reveals only the medium type of chromosomes. The somatic complement consist nineteen pairs of chromosomes with metacentric constrictions (B^m) and remaining five pairs are found with submetacentric constrictions (B^{sm}). The largest chromosome in the complement measures $3.94 \mu m$ and that of the shortest is $2.42 \mu m$. The total haploid chromatin length is $69.3 \mu m$. The karyotype formula for this species is $2n = 48 = 38B^m + 10B^{sm}$.

Meiotic behaviour is normal.

T. bellerica, Roxb. :

This is also the first cytological report from the present work. The somatic metaphase chromosome number of $2n = 48$ is noticed in this species (Fig. 6). The karyotype reveals the presence of only long and medium type of chromosomes. There are eleven pairs of long chromosomes, among them seven pairs are with median primary constrictions (A^m) and four pairs possess submedian primary constrictions (A^{sm}). Among thirteen pairs of medium chromosomes, six pairs are with median primary constrictions (B^m) and seven pairs possess submedian primary constrictions (B^{sm}). In this taxon also the chromosomes are found graded in the order of decrease in length which ranges from $5.6 \mu m$ to $3.2 \mu m$. The total chromatin length of the haploid set is $95.8 \mu m$. The karyotype formula for this taxon is $2n = 48 = 14A^m + 8A^{sm} + 12B^m + 14B^{sm}$.

Meiotic divisions are regular.

DISCUSSION

The genus *Terminalia* is of great importance from the point of view of forestry and sericulture industry, many species yield commercial timber, tannin and several of them are host plants of tropical tasar silkworm (Titmus 1959; Rao and Purkayastha 1972; Jolly *et al* 1974). Hitherto karyomorphological studies have largely been neglected in these economically important taxa. But stray cytological investigations have reported only the chromosome counts in a few species (Sanjappa 1980; Singhal *et al* 1980; Gill *et al* 1981). In the present work, detailed karyotypic studies have been made in six species occurring in Karnataka for the first time. Of the six species *T. catappa*, *T. paniculata*, *T. tomentosa* and *T. arjuna* have revealed the chromosome number of $2n = 24$, whereas two taxa *T. chebula* and *T. bellerica* have revealed $2n = 48$. This number has been reported for the first time from our study.

The general pattern of the karyotypes is more or less similar among the six taxa studied in the present work. The chromosomes bear median to submedian primary constrictions, relatively long and are fairly uniform in their size (range $2 \mu m$ to $6 \mu m$). This is indicative of symmetrical nature of karyotypes. Though, of course, the study reveals uniform type of chromosomes, a marked difference is seen among the species when critically examined. Karyotype of each species differs from the other in relative arm length, absolute length of chromosomes and position of centromere (see chromosomal types). Hence, the karyotype is specific to each taxon. The taxa also show very distinct morphological characters each one differing from the other with respect to habit, leaf shape, fruit shape and size.

From the above observations it is clear that $x = 12$ is the basic number in the genus *Terminalia*. *T. catappa*, *T. paniculata*, *T. tomentosa* and *T. arjuna* with $2n = 24$ are at the diploid level, while *T. chebula* and *T. bellerica* with $2n = 48$ are at the tetraploid level. All these species are sexually fertile and do not show any meiotic irregularities. Evidently, along with allopolyploidy, a change in chromosome structure has been one of the major factors in the evolution of species of the genus *Terminalia*.

ACKNOWLEDGEMENTS

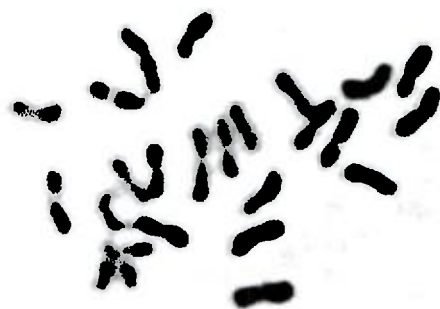
The authors are thankful to Dr. B.N. Chowdaiah, Professor and Head of the Department of Zoology & Co-ordinator, R & D Programme in Sericulture, Jnana Bharathi, Bangalore University, Bangalore, for his encouragement and facilities. The authors

are also grateful to Dr. D.G. Krishnappa, Reader in Botany, Bangalore University, Bangalore, for useful discussions.

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* * *



1



2

Fig. 1. Somatic metaphase chromosomes ($2n = 24$) of *Terminalia catappa*.

Fig. 2. Somatic metaphase chromosomes ($2n = 24$) of *T. arjuna*.

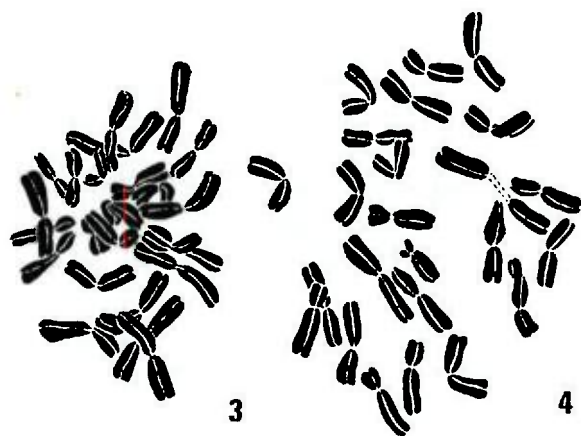


Fig. 3. Somatic metaphase chromosomes ($2n = 24$) of *T. paniculata*.

Fig. 4. Somatic metaphase chromosomes ($2n = 24$) of *T. tomentosus*.

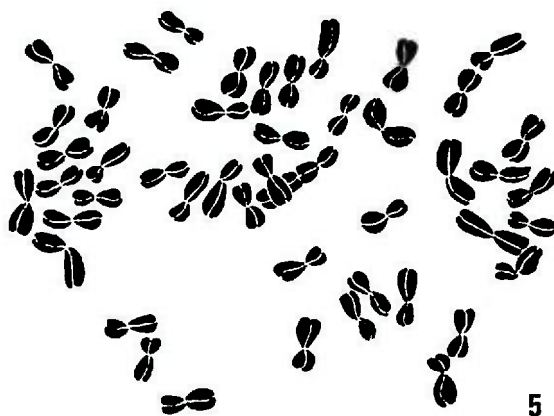


Fig. 5. Somatic metaphase chromosomes ($2n = 48$) of *T. chebula*.

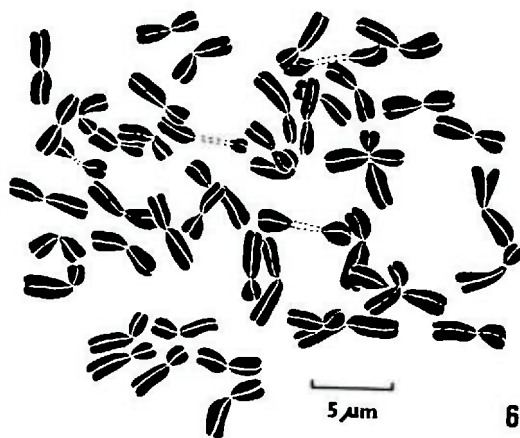
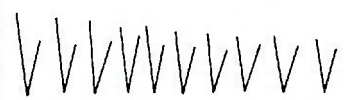
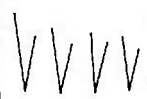
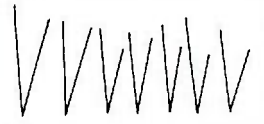
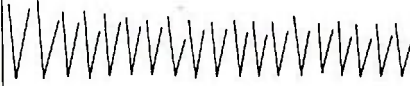
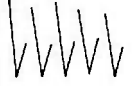
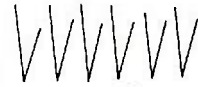
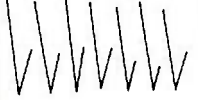


Fig. 6. Somatic metaphase chromosomes ($2n = 48$) of *T. bellerica*.

Note : Figs. 1 and 2 : photomicrographs;

Figs 3, 4, 5 and 6 : camera lucida drawings.

CHROMOSOMAL TYPES IN <u>TERMINALIA</u>					
Species		Long		Medium	
		A ^m	A sm	B ^m	B sm
<u>T. catappa</u> (2n = 24)	Scale ——— 5 μm				
<u>T. paniculata</u> (2n = 24)					
<u>T. tomentosa</u> (2n = 24)					
<u>T. arjuna</u> (2n = 24)					
<u>T. chebula</u> (2n = 48)					
<u>T. bellerica</u> (2n = 48)					

STUDIES ON ASAN (TERMINALIA TOMENTOSA) LEAF CONSUMPTION
BY SUCCESSIVE INSTARS AND DURING THE ENTIRE LARVAL PERIOD
OF ANTHRAEA MYLITTA DRURY

ETUDES SUR LA CONSOMMATION EN FEUILLES D'ASAN (TERMINALIA TOMENTOSA)
PAR ANTHRAEA MYLITTA DRURY AU COURS DES DIFFERENTS AGES LARVAIRES
ET PENDANT LA TOTALITE DE LA PERIODE LARVAIRE

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Antheraea mylitta Drury is a polyphagous silkworm having varieties of primary and secondary food plants. Asan (*Terminalia tomentosa*) is one of the primary host plant. It has been utilized to find out the instar-leaf and cocoon-leaf ratio. Consumption of leaves has been found to be directly proportional to age and shows extra-ordinary increase during the last stage instar (5th stage). It has been calculated that approximately 1.5 kg. of green leaves are required to produce 10 cocoons weighing about 100 gms. or about 230 kg. of leaves are required to produce 1 kahan (1600) or about 26 kg. of cocoons showing a cocoon-leaf ratio of 1:15 (weight/weight).

Antheraea mylitta Drury est un ver à soie polyphage qui se nourrit sur des plantes nourricières primaires et secondaires. Asan (*Terminalia tomentosa*) est l'une des plantes nourricières primaires. Elle a été utilisée pour déterminer les rapports âge larvaire/feuille et cocon/feuille. On a découvert que la consommation de feuilles est directement proportionnelle à l'âge et augmente considérablement au cours du dernier âge larvaire (5ème âge). Les calculs suivants ont été faits : il faut environ 1,5 kg de feuilles vertes pour produire 10 cocons pesant environ 100 g. Autrement dit, 230 kg de feuilles sont nécessaires pour produire 1 kahan (1600) ou environ 26 kg de cocons, ce qui donne un rapport cocon/feuille de 1/15 (poids/poids).

INTRODUCTION

Nutritional ecology of the silkworm is of fundamental importance so far as consumption, digestion and assimilation of host plant leaves and production of cocoons are concerned. It also helps in proper selection of the host plant (Hamamura, 1959) which is more important for the tasar silkworm, *Antheraea mylitta* Drury having a variety of primary and secondary food plants. Some work has been done by Legay (1958), Herie (1962) and Ito (1967) in *Bombyx mori* L. and by Kapil (1963-1967) and Poonia (1978) in *Philosamia ricini* H. This type of work is lacking in the tasar silkworm. The present investigation focuses some light on the leaf consumption by successive instars and during the entire larval period by individual silkworm to produce cocoons and to find out the instar-leaf and cocoon-leaf ratio.

MATERIALS AND METHODS

Ten replications of 100 healthy worms were selected just after hatching and were reared on the leaves of the host plant Asan (*Terminalia tomentosa*) of the identical growth at the State Tasar Research Farm, Durgapur. A buffer stock was maintained in order to keep the number of worms constant in all the replications. This experiment has been continued from 1st season of 1982 to third season of 1983. As the worms have to be reared in nature upon fresh leaves it is not possible to take the initial weight of the foliage of the original host plant. So same amount of foliage was plucked from another plant having identical growth and weighed. The final weight was taken from the residual leaves of the original host plant. The difference between the two weights gives the closest approach to the amount of leaf consumed.

RESULTS AND DISCUSSION

The perusal of the data of the table 1 clearly shows that the 1st instar larva requires 0.25 gms, 2nd instar 1.29 gms, 3rd instar 4.14 gms, 4th instar 17.12 gms and 5th instar 120.1 gms of Asan leaves for their consumption and all total 142.91 gms of leaves are required by a single worm to produce a single cocoon. The leaf consumption is the lowest during the 1st instar larva and it gradually increases till the 4th stage and is highly accelerated during the 5th stage (Fig. 1 & 2).

Percentage value (PV) and relative value (RV) of leaf consumption by a particular instar with respect to other instars and to the total leaf consumption can very easily be found out from the table 2. It is interesting to note that 84% of the total leaf is consumed by the 5th instar larvae and only 16% by the other 4 instars distributing 0.17% by 1st instar, 0.90% by 2nd instar, 2.89% by 3rd instar and 11.97% by 4th instar larva.

Leaf instar ratio has been deduced from table 1 and shown in table 3. So it is concluded that 400 1st instar larvae, 77 2nd instar larvae, 24 3rd instar larvae and 5 4th instar larvae can be reared on a Asan plant producing 100 gms. of leaves. Similarly, a plant producing 1 kg of foliage is sufficient enough for 40,000 1st instar larvae or 7751 2nd instar larvae or 2415 3rd instar larvae or 584 4th instar larvae or 83 5th instar larvae. Like-wise we are able to calculate how many numbers of worms of a particular instar are required for a particular amount of foliage.

Instar leaf ratio has also been obtained from computation of table 1 and as shown in table 4. It shows how much amount of leaf is required by a particular number of worms to produce a particular number of cocoons. For production of one Kahan 1600 in number of 16 kg of cocoons (at 1 cocoon = 10 gms), 228 kg 640 gms of Asan leaves are required. Similarly, 572 gms of leaves are required for one ganda 4 nos or 40

gms and 11 kg 432 gms of leaves for one pan 80 numbers or 800 gms of cocoon harvest. The cocoon : leaf ratio thus comes to about 1:15 (weight/weight).

Some authors like Evans (1939a) in *Aglaia urticae*, *Malacosoma neustria* and in *pieris brassicae*, Mishra (1962) in *Camula pellucida*, Carne (1966) in *Paropsis atomaria*, Delvi & Pandian (1972) in *Poecilocerus pictus*, Kogan & Cope (1974) in *Pseudoplusia includens*, Poonia (1978) in *Philosamia ricini* have shown an inverse relationship of food consumption with age i.e. early developmental stages consume high amount of food. But in *Antheraea mylitta* Drury it has been found out by the above experiment that the food consumption is directly proportional to age and shows extraordinary increase during the last stage of the larva i.e. 5th instar larva.

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Season	No. of larvae in each replication	Average leaf consumption in gms by the instars					Per replication
		1st	2nd	3rd	4th	5th	
1st 1982	100	36.9	139.0	393.0	1519.5	14325.5	16413.9
2nd 1982	100	29.5	129.6	393.3	2148.0	12001.0	14701.6
3rd 1982	100	15.5	98.1	446.2	1674.2	11314.1	13548.1
1st 1983	100	17.5	103.7	415.1	1723.6	10878.4	13137.95
2nd 1983	100	19.0	106.9	416.0	1765.7	11115.7	13423.3
3rd 1983	100	32.3	197.9	421.8	1444.1	12425.6	14521.7
Total	600	150.7	775.2	2485.4	10275.1	72060.3	85746.55
Average leaf consumption per replication	100	25.13	129.2	414.23	1712.51	12010.05	14291.09
Average leaf consumption per larvae	1	0.2513	1.292	4.1423	17.1251	120.1005	142.9109

Table 1. Showing the total leaf consumption and the average quantum of leaf consumption by successive instars of *Antheraea mylitta* D.

Stage of instars	Leaf consumed by a single worm in gms.	VALUE OF LEAF CONSUMPTION BY SUCCESSIVE INSTARS											
		1st instar		2nd instar		3rd instar		4th instar		5th instar		Total amount	
		RV	PV	RV	PV	RV	PV	RV	PV	RV	PV	RV	PV
1st	0.25	1	100	0.19	19.3	0.06	6.0	0.0146	1.46	0.002	0.2	0.0017	0.17
2nd	1.29	5.16	516	1	100	0.31	31.15	0.075	7.53	0.01	1.07	0.009	0.9
3rd	4.14	16.56	1656	3.2	320.93	1	100	0.24	24.18	0.34	3.44	0.28	2.896
4th	17.12	68.48	6848	13.27	1327.13	4.13	413.52	1	100	0.1425	14.25	0.1197	11.97
5th	120.1	480.4	48040	93.1	9310.07	29.0	2900.96	7.01	701.51	1	100	0.84	84.03
Total	142.91	571.64	57164	110.78	11078.29	34.51	3451.93	8.34	834.75	1.18	118.99	1	100

Table 2. Showing the percentage value (PV) and relative value (RV) of leaf consumption by successive instars in comparison to the total leaf consumed and the leaf by other instars in *Antheraea mylitta* D.

Quantum of leaves	NUMBER OF WORMS REARED				
	1st instar	2nd instar	3rd instar	4th instar	5th instar
100 gms.	400	77	24	5	-
1 kg.	44,000	775	241	58	8
10 kgs.	40,000	7,751	2,415	584	83
100 kgs.	400,000	77,519	24,154	5,841	832

Table 3. Showing leaf-instar ratio in *Antheraea mylitta* D.

Number of worms reared	QUANTUM OF FOLIAGE REQUIRED BY DIFFERENT INSTARS						Cocoons harvested
	1st instar	2nd instar	3rd instar	4th instar	5th instar	Total leaf	
1	0.25	1.29	4.14	17.12	120.1	142.9	1
4	1.0	5.16	16.56	68.48	480.8	571.6	4 *
10	2.5	12.9	41.4	171.2	1,201.0	1,429.0	10
80	20.0	103.2	331.2	1,369.6	9,608.0	11,432.0	80**
100	25.0	129.0	414.0	1,712.0	12,010.0	14,290.0	100
1000	250.0	1,290.0	4,140.0	17,120.0	120,100.0	142,900.0	1000
1600	400.0	2,064.0	6,624.0	27,392.0	192,160.0	228,640.0	1600***

* 1 ganda

** 1 pan

*** 1 kahan

Table 4. Showing the instar-leaf ratio and the cocoon-leaf ratio in *Antheraea mylitta* D.

DEVELOPMENT OF AN ARTIFICIAL DIET FOR THE TROPICAL TASAR
SILKWORM ANTHRAEA MYLITTA D.

MISE AU POINT D'UN ALIMENT ARTIFICIEL
POUR LE VER A SOIE TASSAR TROPICAL ANTHRAEA MYLITTA D.

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Attempt has been made to develop an artificial diet for the tropical tasar silkworm, *Antheraea mylitta* D. It can be instrumental in boosting laboratory research with this animal and for the introduction of a mulberry type "chawki" rearing for the tasar. First trials were made with compositions made in the line of artificial diets used for *Bombyx mori* after obvious modifications. Out of these recipe, one the 'SS-8' was found to perform better. Further work on modification and improvisation of this diet resulted in the 'SS-11'. This recipe containing a small quantity of dried arjun leaf powder can be cooked within a few minutes and stored upto days together in a refrigerator.

Tasar silkworms reared on SS-11 in perforated plastic boxes during the first 72 hours showed comparable growth and survivability with that of the control. This artificial diet, therefore, is suggested as a suitable substitute food for rearing of early stage worms in the controlled laboratory conditions.

Des études ont été faites pour développer un aliment artificiel pour le ver à soie tassar tropical *Antheraea mylitta* D. ce qui permettrait d'utiliser cet animal pour des recherches en laboratoire et d'introduire un élevage "chawki" de type mûrier pour le tassar. Des essais ont été effectués à partir des préparations du même type que celles des aliments artificiels utilisés pour *Bombyx mori*, mais avec des modifications appropriées. Parmi ces préparations, la "SS-8" apparaît la plus performante. Des études plus approfondies sur la modification et la mise au point de ce régime alimentaire ont abouti au "SS-11". Ce régime qui contient une faible quantité de poudre de feuille arjun peut être préparé en quelques minutes et se conserve pendant des jours dans un réfrigérateur.

Les vers à soie tassar élevés sur "SS-11" dans des boîtes perforées en plastique pendant les 72 premières heures, ont une croissance et un taux de survie comparables à ceux des larves contrôle. Cet aliment artificiel peut être donc considéré comme un bon aliment de substitution pour l'élevage des jeunes vers en laboratoire.

INTRODUCTION

Successful use of artificial diet for rearing of *Bombyx mori* L. worms have facilitated research in diverse fields like silkworm physiology, genetics and pathology (Maura, 1983; Yamamoto, 1983 and Miyajima *et al.*, 1983). Needless to say, such a synthetic/semisynthetic diet for the tasar silkworm, if developed, could open new avenues of research as it could then be reared under controlled conditions like any other laboratory animal. Moreover, it could make possible introduction of a mulberry type "chawki" rearing for tasar. Work has been continuing in Japan to prepare such diets for non-mulberry silkworms also (see Sengupta, 1981). However, there has been no report yet in literature suggesting a suitable artificial diet for *Antheraea mylitta* D.

A systematic approach had been undertaken since 1981 in the authors' laboratory to develop the much wanted recipe. However, at initial stage, it seemed reasonable to concentrate on the rearing of only early stage worms and the emphasis has been more on acceptability and nutritiveness of the food rather than on economy.

The present paper while recording the progress so far made, suggests an artificial diet that has been found to be a suitable substitute food for the tropical tasar silkworm *Antheraea mylitta* D. during the first 72 hours of indoor rearing.

MATERIAL AND METHODS

Different synthetic/semisynthetic compositions in the line of artificial diets used for *B. mori* worms (Ito and Kobayashi, 1978) after obvious modifications needed for *A. mylitta* were tried on early stage tasar silkworms taken in large glass petri-dishes. Growth and survival rate of the worms reared on the recipe were taken as the parameters to assess their suitability and the diets were modified gradually to meet the deficiencies.

Out of several compositions tried, 'SS-8' (Table 1) was found to be the best. Although worms immediately did not show any attraction for the recipe, they were found to feed upon it after some time. However, it didn't give optimum survival and health. When improved by addition of dried Arjun (*Terminalia arjuna*) leaf powder, this food (now labelled SS-9) became readily acceptable to the worms and also resulted in better health of the worms. However, water often oozed out of the food causing entanglement and death of the young larvae. This was overcome by a step mentioned later.

In a second set of experiments the worms were separately fed on tender, medium and coarse (matured) arjun/asan (*Terminalia tomentosa*) leaf powders plus a pinch of Streptomycin made into semisolid paste with distilled water. Out of these, those fed on matured arjun leaf powder were found to have better growth than others. However such diets containing virtually nothing but leaf powder, had very little capacity to retain water. Thus, taking note of the findings from the above, two sets of experiments were taken up and SS-9 was modified to prepare a better recipe viz. SS-10 as follows :

1. Along with other ingredients, only matured arjun leaf powder was used to make the food more acceptable and nutritious for the worms.

2. Quantity of cellulose powder was cut down as the leaf powder itself provides an appreciable amount of it.

3. Agar was added to get a semisolid food having higher water retention capacity. Indeed the recipe now was found to perform much better.

Further, when sorbic acid was added, water content reduced and perforated plastic boxes with lids were used for rearing, very encouraging result was obtained with this recipe viz. SS-11 (table 1).

For preparation of the food, all the constituents except Streptomycin were first made into a paste with water. The mixture was thoroughly mixed in a grinder-cummixer and then was boiled slowly while stirring continuously for about five minutes. Streptomycin (dissolved in water) was added after cooling. The cooled food was then cut into cubes for feeding. This recipe could be stored in a refrigerator upto several days without any risk of its deterioration in performance.

Whenever a control was taken, the worms were reared on fresh arjun leaves inside perforated plastic boxes/glass petridishes. For comparison of rearing performance on SS-11 and control five replications were taken for each.

OBSERVATION AND DISCUSSION

Worms fed on SS-11 when inspected after 72 hours were comparatively yellowish in colour than those in control. This was presumably, due to lower chlorophyll content of the artificial diet. From this it can further be assumed that colour of the worms, at least in early stages, is affected by the type of food provided. Growth and survivability of the worms in experimental lots were quite comparable to that of the control (Table 2). The difference between the treated and control lots were found to be statistically insignificant (Table 3). As SS-11 showed promising results some lots after rearing on this diet for 72 hours were transferred to outdoor bushes for further rearing. These worms spun cocoons as good as those of the control set. However, this would be further verified taking larger samples.

Trial was also being made on composition containing all ingredients of SS-11 but dried sal (*Shorea robusta*) instead of arjun (*Terminalia arjuna*) leaf powder. This resulted in deterioration in the health of the worms. Thus observations so far made suggest that *A. mylitta* worms can successfully be reared indoors on the artificial diet SS-11 upto the first 72 hours.

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SS-8

1. Sucrose	2 gms
2. Soyabin meal	6 gms
3. B-Sitosterol	100 mg
4. Ascorbic acid	400 mg
5. Cellulose powder	6 gm
6. Citric acid	100 mg
7. Riboflavin	added
8. Streptomycin	added
9. Distilled water	60 ml

SS-11

1. Sucrose	2 gm
2. Soyabin meal	6 gm
3. B-Sitosterol	100 mg
4. Ascorbic acid	400 mg
5. Cellulose powder	2 gm
6. Citric acid	100 mg
7. Matured Arjun leaf powder	2 gm
8. Agar agar (Bacteriological)	1 gm
9. Sorbic acid	40 mg
10. Riboflavin	2 mg
11. Streptomycin	added
12 Distilled water	50 ml.

Table 1. Composition of two different artificial diets tried on the early stage tasar silkworms.

Replication No.	Treatment	By the end of 72 hrs. rearing		
		Mortality (%)	Av. wt. of larvae (mg)	Colour of the worms
1	SS-11	19.0	59.5	Lemon green
2	do	15.6	53.5	do
3	do	6.9	65.2	do
4	do	2.7	49.7	do
5	do	5.8	34.2	do
Average	SS-11	10.0	52.4	Lemon green
1	Arjun leaves (control)	15.0	51.6	Green
2	do	6.6	60.0	do
3	do	12.5	56.1	do
4	do	15.3	40.6	do
5	do	2.7	58.4	do
Average	Control	10.42	53.34	Green

Table 2. Comparative rearing of *A. mylitta* worms on the Artificial diet SS-11 and arjun leaves (control)

Different values	Character	Mortality %	Average wt. of larvae (mg)
Mean values	Treatment (S-11)	10.10 (17.55)	52.42
	Control	10.42 (18.17)	53.34
Calculated value of "t"		0.157	0.200
Tabular value of "t" (5%)		2.306	2.306
Degree of freedom (O.F.)		8	8
Conclusion		N.S.	N.S.

N.S. - Not significant.

Data in parenthesis are in degree.

Table 3. Statistical analysis of the data on comparative rearing of *A. mylitta* worms on SS-11 and Arjun leaves (control).

CHANGES IN PROTEIN CONTENT IN THE LARVAL AND PUPAL
HAEMOLYMPH OF ANTHERAEA MYLITTA D.

VARIATION DU CONTENU EN PROTEINES DE L'HEMOLYMPHE CHEZ LA LARVE
ET LA CHRYSALIDE DE ANTHERAEA MYLITTA D.

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Studies on the changes in protein content in the larval and pupal haemolymph have revealed that protein content in the haemolymph increases enormously during larval development. However, an entirely opposite situation has been found during metamorphosis. There are two stages which show a distinct drop in protein concentration, firstly during the transformation of larva into pupa and secondly at the time of adult emergence. In addition to this it has been observed that haemolymph of female pupae contains more protein in comparison to their male counterpart.

Les études sur les changements de la teneur en protéine dans l'hémolymph de la larve et de la nymphe ont révélé que la teneur en protéines dans l'hémolymph augmente d'une manière considérable au cours du développement larvaire. Cependant, nous avons découvert une situation inverse au cours de la métamorphose. La concentration de protéine décroît nettement au cours des deux stades suivants : premièrement, pendant la transformation de la larve en nymphe, et deuxièmement au moment de l'émergence du papillon adulte. De plus, on a observé que l'hémolymph des chrysalides femelles contient plus de protéines que celle des mâles.

INTRODUCTION

Various aspects of protein metabolism in insect development, such as patterns of free amino acids pools, the intermediary pathways of individual amino acids and their derivatives, qualitative and quantitative changes in haemolymph proteins as well as the synthesis and metabolic activity of specific enzymes have attracted the interest of many insect biochemists during the recent past.

According to Laufer (1960), Chippendale and Beck (1966), Pantelouris and Downer (1969) the haemolymph proteins of insect show mostly quantitative but barely qualitative differences. Several possible roles for haemolymph proteins have been postulated, for example, they may function as enzymes (Laufer, 1960), they may serve as an amino acid reserve for adult tissues (Dinamarca and Levenbook, 1966) or they may be used intact in constructing adult structures (Loughton and West, 1965). Extensive research work has been conducted in regard to insect haemolymph by a large number of scientific workers. However, no work has been done on the changes in protein content in *Antheraea mylitta* D. The present paper deals with the changes in protein content in the larval and pupal haemolymph of *Antheraea mylitta* D.

MATERIALS AND METHODS

Larvae of *Antheraea mylitta* D. were reared on *Terminalia arjuna*. Larval haemolymph during the 3rd, 4th and 5th instars and two corresponding moults and pupal haemolymph from 0 to 15 days with an interval of 5 days from the harvest of first crop (non-diapausing) and 0 to 210 days age with an interval of 15 days from the harvest of second crop (diapausing) were collected separately. Haemolymph (1 ml) of each stage was taken and used for estimation of proteins.

Proteins were precipitated from haemolymph by addition of trichloroacetic acid (4.5 ml, 6% w/v). The contents were mixed well and kept in cold for about 10 minutes. The precipitated proteins were centrifuged and the supernatant liquid was rejected. The precipitate was washed with 5 ml portions of trichloroacetic acid and then dissolved in sodium hydroxide (8 ml, 0.1 N). Proteins were estimated in this extract by the method of Lowry *et al.*, (1951).

RESULTS AND DISCUSSION

Changes in protein content in the larval and pupal haemolymph of *Antheraea mylitta* D. during the two crops have been shown in figures 1 and 2.

From figures 1 and 2 it is seen that protein content in the haemolymph increases enormously during larval development. Protein content in the haemolymph is the least in the third instar larvae, rises during fourth and fifth instars and reaches the maximum in the spinning larvae during both the rearing seasons.

An entirely opposite situation has been found during metamorphosis. There are two stages which show a distinct drop in protein concentration; firstly at the time of transformation of larva into pupa and secondly at the time of adult emergence (figures 1 and 2). Between these two periods the protein concentration remains at a rather constant level.

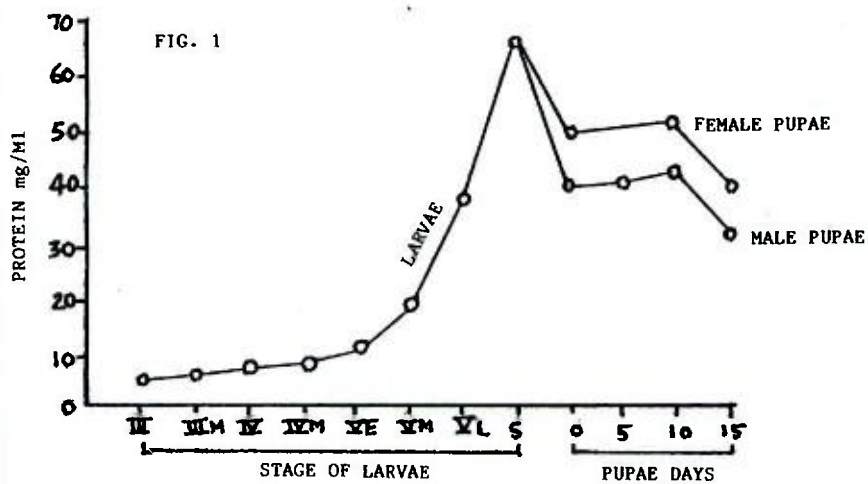
The change in protein concentration in the haemolymph of the developing larvae of *Antheraea mylitta* D. is similar to those reported in *Hyalophora cecropia* (Chefurka, 1953), *Popilla japonica* (Ludwig, 1954), *Phormia regina* (Chen and Levenbook, 1966) and *Bombyx mori* (Wyatt et al., 1956). In all the cases the protein content has been observed to rise rapidly in the growing larvae, decreasing in the pupa and falling sharply at the time of adult emergence.

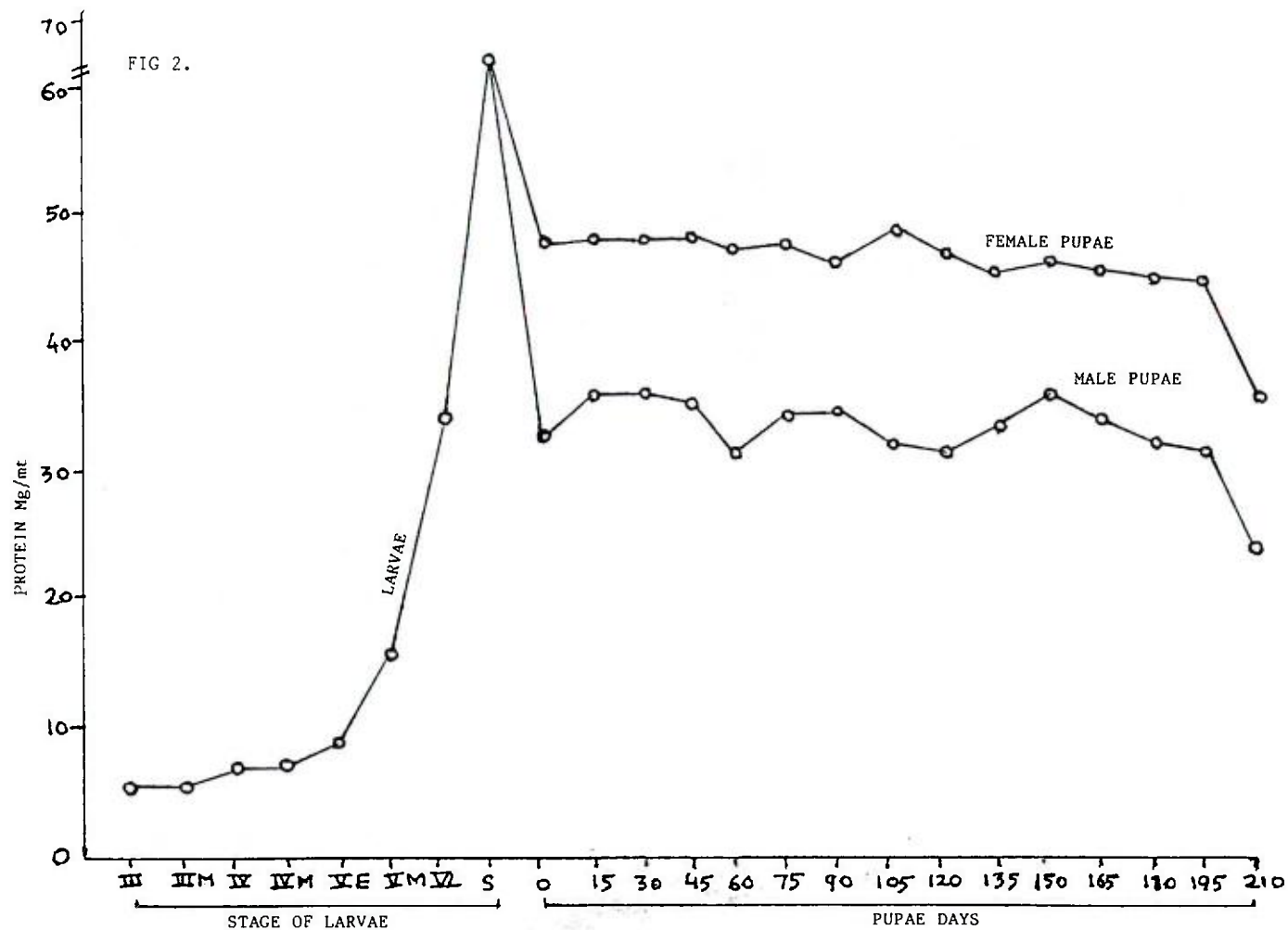
The fall in the protein content during the transformation of larva into pupa at the time of adult emergence seems to have resulted on account of their utilization for the formation of tissue and organ-specific proteins of pupa and adult. This conclusion is supported by the findings of Chen and Levenbook (1966). According to them, the haemolymph proteins serve as an important source for the synthesis of adult tissue proteins.

It is further evident from figures 1 and 2 that the protein content in case of female pupae is higher in comparison to male counterpart suggesting higher requirement of protein in the female during the course of their metamorphosis.

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VARIABILITY AND CORRELATION STUDIES OF SHELL WEIGHT
AND THEIR CONTRIBUTING TRAITS IN A. MYLITTA D.

ETUDES DE LA VARIABILITE DU POIDS DE LA COQUE SOYEUSE
ET DE LA CORRELATION AVEC LES CARACTERES ASSOCIES CHEZ A. MYLITTA D.

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Phenotypic and genotypic variabilities were studied in shell weight and their 8 contributing characters. A wide range of phenotypic variability was observed. The trait cocoon weight gave the highest estimate of genetic coefficient of variation followed by silk ratio and eggs laid. Estimates of heritability in broad sense were high for cocoon weight, shell weight, silk ratio and moth weight. Shell weight was found to have high genetic advance.

Genetic and phenotypic association between shell weight and their contributing traits were also carried out. Shell weight was positively and significantly co-related with cocoon weight, larval weight and moth weight. Among themselves too, these traits showed positive and significant relationship both at genotypic and phenotypic level. Moth weight exhibited positive association with pupal weight, eggs laid, total nos. of eggs (laid + unlaid) and egg-laying coefficient. Thus from the present study the characters viz. larval weight, moth weight and eggs laid may be recommended as reliable selection indices.

Nous avons étudié les variabilités phénotypiques et génotypiques du poids de la coque soyeuse ainsi que des 8 caractères qui y contribuent. Nous avons observé un large éventail de variabilité phénotypique. La plus forte estimation du coefficient de variation génétique est donnée par la caractéristique poids du cocon, puis par la richesse soyeuse et le nombre d'oeufs. L'héritabilité du poids du cocon, du poids de la coque, de la richesse soyeuse et du poids du papillon est très élevée. Le poids de la coque montre une évolution génétique importante.

Nous avons également étudié l'association génétique et phénotypique entre le poids de la coque soyeuse et les caractères qui y contribuent. Le poids de la coque soyeuse est corrélé de manière positive et significative au poids du cocon, au poids de la larve et celui du papillon. Ces caractères montrent également entre eux une relation positive et significative à la fois au niveau génotypique et phénotypique. Le poids du papillon est corrélé positivement au poids de la nymphe, au nombre d'oeufs pondus, au nombre total d'oeufs (pondus et non pondus) et au coefficient de ponte. Ainsi, cette étude montre que les caractères suivants : poids de la larve, poids du papillon et nombre d'oeufs pondus, peuvent être considérés comme des indices de sélection fiables.

INTRODUCTION

Crop improvement depends upon the magnitude of genetic variability and the extent to which the desirable quantitative characters are heritable. A critical estimate of heritability of different quantitative characters is thus a pre-requisite for planning a breeding programme. Estimates of genetic association along with the phenotypic co-relations, not only display a clear picture of the extent inherent association but also indicate how much of the phenotypically expressed co-relation is influenced environment. Therefore, the present investigation were undertaken to evaluate the genetic variability and association of shell weight with its contributing traits.

MATERIALS AND METHODS

30 emerged mother moths in 3 replications were kept for coupling individually in separate cages. The decoupled mother moths were weighed individually and placed for egg-laying in separate boxes. After 72 hours, eggs were collected, counted, disinfected and then kept for incubation at room temperature. The mother moths were dissected to find out the number of unlaidd eggs inside the abdomen. The egg-laying coefficient was calculated by the formula :
$$\frac{\text{No. of egg laid} \times 100}{\text{Total No. of eggs present}}$$
 After completion of incubation, the hatched worms were mounted on *T. arjuna* leaves. 30 matured larvae in 3 replications were weighed and kept for spinning separately. After completion of serideposition, all the ripe cocoons were harvested separately and assessed for the economic characters such as, cocoon weight (g), pupal weight (g), shell weight (g) and silk ratio respectively.

The analysis of variance was done in the method suggested by Panse and Sukhatme (1967). Heritability (in broad sense) and expected genetic advance at 5% selection intensity was estimated according to the method given by Allard (1960). Genotypic and phenotypic coefficient of variability (GCV, PCV) were calculated according to the method suggested by Burton (1952). Phenotypic and genotypic co-relation were studied following the method of Miller *et al.*, 1958.

RESULTS AND DISCUSSION

Range, mean and variability parameters for shell weight and its contributing characters are given in Table 1. The data indicates that characters like cocoon weight, eggs laid and silk ratio had high genetic coefficient of variation. Burton (1952) had advocated that a genetic coefficient of variation together with the heritability would give the best picture of the amount of advance to be expected from selection.

High heritability values have been obtained for cocoon weight, shell weight, silk ratio and moth weight. Total Nos. of eggs, pupal weight, larval weight, egg laying coefficient and no. of eggs laid have the moderate heritability.

Estimates of genetic advance expressed as percentage of mean revealed large differences among the 9 traits. Only one trait namely shell weight had high genetic advance while the other characters had low genetic advance. Thus the heritability and genetic advance estimates were substantially high for shell weight indicating that additive gene effects are perhaps important for the traits. And as such, selection for these characters could prove quite effective. High heritability with low genetic gain observed for silk ratio, moth-weight, is possibly due to intra and inter allelic interaction, recurrent selection may be helpful to improve these traits. The other characters viz. total No. of eggs pupal weight, larval weight and no. of eggs laid had moderate heritability with low genetic advance which suggests that moderate heritability estimate is due to non-additive (dominance + epistatic) gene effects, (Panse, 1957). Further, moth weight, larval weight, had low genetic coefficient of variation which indicates low genetic variability for these characters. This has been clearly reflected in the low estimate of genetic advance for moth weight and larval weight. The result is in close agreement with the findings of Jolly *et al.*, 1974.

A knowledge of inter-relationship of certain contributing characters with shell weight and among themselves is also of paramount importance to the breeder for making improvement in a certain character like shell weight. With this object, genotypic and phenotypic co-relation coefficient between different contributing characters with shell weight and also among themselves were also studied. The estimates of phenotypic (P) & genotypic (G) co-relation coefficient among the 9 characters are presented in Table 2. Shell weight was positively correlated with cocoon weight, larval weight and moth weight. Among themselves too, these traits showed positive and significant relationship both at genetic and phenotypic level. Moth weight exhibited positive association with pupal weight at phenotypic level, eggs laid, total no. of eggs (laid + unlaid) and egg laying coefficient. Pupal weight also positively associated with no. of eggs laid, total no. of eggs at phenotypic level, egg laying coefficient, shell weight and silk ratio. No. of eggs laid, total no. of eggs and egg laying coefficient were positively and significantly correlated with each other. The relationship between no. of eggs laid and total no. of eggs were also positively correlated with shell weight. Thus, from the present studies, the three characters viz. larval weight, moth weight, and no. of eggs laid may be recommended as reliable selection indices. However, the confirmation of these studies will be done after path coefficient analysis by the authors.

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Variability parameters	Moth weight (g)	No. of eggs laid	Total No. of eggs (laid + unlaid)	Egg laying coefficient (%)	Larval weight (g)	Cocoon weight (g)	Pupal weight (g)	shell weight (g)	Silk ratio (%)
Genotypic coefficient of variability (%)	3.84	44.98	11.36	11.50	5.30	76.17	17.22	4.63	46.18
Phenotypic coefficient of variability (%)	6.20	63.49	8.78	16.01	7.08	84.70	23.17	5.24	53.49
Heritability (%)	62.01	50.32	59.72	51.83	57.35	80.86	58.49	78.13	74.60
Genetic advance in % of mean	4.25	3.45	4.10	3.56	3.94	14.81	12.39	93.51	11.30
Mean	5.46	151.50	260.37	58.76	38.57	11.36	9.82	1.52	13.75
Range	3.4-6.7	54-230	179-365	22.50-94.26	31.2-46.4	10.82-13.50	8.77-11.05	0.75-1.80	12.25-15.80

Table 1. Estimates of variability parameters, heritability and genetic advance of shell weight and their contributing traits of *Antheraea mylitta* D.

		Larval weight (g)	Moth weight (g)	Pupal weight (g)	No. of eggs laid	Total no. of eggs (laid + unlaid)	Egg laying coefficient (%)	Silk ratio (%)	Shell weight (g)
Cocoon weight (g)	P	0.7236**	0.7418**	0.6145**	0.6962**	0.7328**	0.7020**	0.2188	0.8176**
	G	0.6609**	0.6908**	0.2866	0.6116**	0.6765**	0.6260**	0.1363	0.5276**
Larval weight (g)	P		0.5958**	0.6860**	0.6442**	0.6712**	0.6485**	0.7029**	0.8027**
	G		0.5951**	0.2423	0.5360**	0.1853	0.5444**	0.2532	0.2292
Moth weight (g)	P			0.6685**	0.7384**	0.8087**	0.7504**	0.1833	0.8773**
	G			0.3362	0.6560**	0.6852**	0.6606**	0.1276	0.6292**
Pupal weight (g)	P				0.7144**	0.6769**	0.7081**	0.6001**	0.4056*
	G				0.6134**	0.2475	0.4801*	0.2746	0.1932
No. of eggs laid	P					0.6502**	0.6303**	0.2659	0.9260**
	G					0.5462**	0.5105**	0.1212	0.4236**
Total no. of eggs (laid + unlaid)	P						0.6547**	0.2482	0.8861**
	G						0.5540**	0.1264	0.4641
Egg laying coefficient (%)	P							0.3154	0.4229
	G							0.2702	0.3649
Silk ratio (%)	P								0.3194
	G								0.2100

* significant at 1%

** significant at 5% level of significance

Table 2. Phenotypic and genotypic co-relation coefficient of shell weight and their contributions traits.

NON-MULBERRY SILKWORM REARING IN JAPAN WITH SPECIAL REFERENCE
TO JAPANESE OAK SILKWORM, ANTHARAEA YAMAMAI

ELEVAGE DES VERS A SOIE NON-MURIER AU JAPON, ET EN PARTICULIER
DU VER A SOIE DU CHENE JAPONAIS, ANTHARAEA YAMAMAI

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Antharaea yamamai is a representative non-mulberry silkworm which is Japanese native. They inhabit widely through the whole land of Japan, feeding on leaves of *Quercus* plants, such as *Q. accutissima*, *Q. serrata*, *Q. dentata* and *Q. myrsinaefolia*, etc. *A. yamamai* is univoltine. The eggs usually hatch from late April to early May in natural condition. Under favorable climatic and hygienic environments in indoor rearing the larvae make cocoons 24-28 days after the hatching. The silk fiber is characterized by graceful gloss, thick size of fiber, large elongation rate, and stain abilities. The textiles woven by this silk are also characterized with strong, durability, less wrinkle, and rustic touch. The demand of the silk is increasing by use of materials for various textiles, furnitures, interior decorations and so on.

Antharaea yamamai, d'origine japonaise, est un ver à soie non-mûrier représentatif. Il est largement répandu au Japon et se nourrit de feuilles de chênes tels que *Quercus accutissima*, *Q. serrata*, *Q. dentata* et *Q. myrsinaefolia*, etc. *A. yamamai* est monovoltin. Les oeufs éclosent généralement de la fin du mois d'avril jusqu'au début du mois de mai dans des conditions naturelles. Lorsque les conditions climatiques et d'hygiène sont bonnes, les larves élevées en intérieur font leurs cocons entre 24 et 28 jours après l'éclosion. Les fibres de soie se caractérisent par un très beau lustre, leur épaisseur, un taux d'élongation important et une bonne capacité tinctoriale. Les textiles tissés avec ces fibres sont solides, moins froissables, et ont un toucher rustique. La demande en soie augmente grâce à son utilisation pour divers textiles, meubles, décorations intérieures, etc.

I. NON-MULBERRY SILKWORMS IN JAPAN

Three species of non-mulberry silkworm, *Antheraea yamamai* Guérin-Meneville, *Samia cynthia pryeri* Butler, and *Dictyoploca japonica* Moore inhabit widely and have been reared in Japan. In addition, two species of foreign origin non-mulberry silkworm, *Antheraea pernyi* Guérin-Meneville and *Samia cynthia ricini* Donovan are also reared in institutes.

A. yamamai (Japanese oak silkworm) is a representative wild silkworm which is Japanese native. They have been reared on industrial base and studied by entomologist, for reasons of an unique insect producing a characteristic silk. By old Japanese literature, the rearing of *A. yamamai* began in Ten-meï era (1781-1789) in Ariake district located in the piedmont of Japan North Alps in Nagano prefecture. In the beginning, the eggs collected from a habitat were reared on oak trees in the open. Since then, *A. yamamai* rearing has been continued more than two hundred years.

A. pernyi was brought to the Ariake district from China in 1875, and were reared on industrial base for a time, and then, their rearing declined gradually with the lapse of time. *Samia cynthia ricini* was also brought to Japan from India via Taiwan in 1938, and their rearing was tried temporarily with the intention of a substitute for wool. However, this attempt was not succeeded because of difficulty to keep this non-hibernating animal through the cold winter season in Japan. Both *Samia cynthia ricini* and *Dictyoploca japonica* are reared by small scale at present, and their silk fibers are utilized as the materials for spun silk yarns.

The most important non-mulberry silkworm utilized in commercial base is *A. yamamai* and their rearing areas have been spread in several parts of Japan. In Nagano prefecture, about 50 farmers yields 500-700 kg of cocoon per year, and 30-35 kg of silk are obtained by these cocoons.

Recently, mix-woven textiles by two sorts of silk, *Bombyx* and *A. yamamai* resulted in increased demand on account of higher textile qualities. In addition, the demand of *A. yamamai* silk is also increasing by use of materials for various textiles, furnitures and interior decorations. The price is higher than *Bombyx* silk about 50 times.

II. ECOLOGY OF *A. YAMAMAI*

A. yamamai inhabits in plains and mountainous areas through Japanese islands, and they feed mainly on leaves of *Quercus* plants. The eggs usually hatch from end of April to beginning of May in natural condition. When these eggs pass through the diapause they hatch after 4-10 days in incubation room at 25°C.

The larvae respond sensitively to physical stimuli, such as shock, sound, touch, and so on. When the larvae were spurred by such stimulus, they stop eating and shrink their bodies. They prefer to live in the solitary environment than the aggregative, and they harm each other under crowded condition. The animals have so strong grasping power of legs, and they move actively particularly at the stage before cocooning. The optimal temperature for the rearing differ through the larval stages, and it is about 29°C in 1st to 2nd instar, about 27°C in 3rd instar, and about 25°C in 4th to 5th instar, respectively. As to the photoperiod, it is elucidated that a cycle of 10-12 hrs of light and 12-14 hrs of darkness is most effective for the growth and the quantitative characters of cocoon. Air currents are needed for the rearing. The continuous air current of 0.1-0.2 m/sec is desirable for larval growth, particularly in 4th to 5th instar. However, stronger current beyond 1m/sec bring undesirable results.

A larva ingests approximately 43 g of fresh leaves in whole larval period (about 74 % in 5th instar). They have a habit of drinking water. Therefore, the breeders have to supply the water in indoor rearing, though they have some chance to take it in case of the outdoor rearing. Under the favorable climatic and hygienic environments in indoor rearing the larvae make cocoons from 24 to 28 days after the hatching. The cocoon colour is dark green in the case of outdoor rearing while yellow in indoor. The colour varies depending on a quantity of light irradiated on the first day of spinning. The more the light is given, the darker the green colour. Weight of cocoon is usually 8 g in female, and 6 g in male, and the cocoon shell is usually 0.7 g in female and 0.6 g in male.

Most of the pupae pass through the hot summer season as the state of diapause. The animals act emergence, copulation and oviposition only in the night time. The oviposition begins from the night of next day after copulation, and lasts for some days except in daytimes.

The number of eggs laid by one moth is usually 150-250. Their eggs hibernate as the embryos which are already developed to the larvae just before hatching. *A. yamamai* is univoltine, and they are usually reared once a year. If the eggs in diapause are kept at low temperature, however, they are able to be hatched due to the same effect as the hibernation.

III. FOOD PLANTS AND ARTIFICIAL DIETS OF *A. YAMAMAI*

Quercus accutissima Carruth, *Q. serrata* Thunb, *Q. dentata* Thunb, and *Q. myrsinaefolia* Blume are available as food plants of *A. yamamai*. The former three are deciduous while the last one is evergreen. As compared with mulberry trees, the plants are slow-growing with low regenerating ability after cutting, and their leaves are liable to become hard, and less nutritive. Food leaves show a decrease of water content in a short time after leaf emergence. Many insect pests eat the leaves and they may possibly transmit some diseases to *A. yamamai*.

Recent artificial diets improved their food values as same as fresh food plant leaves. The composition of the artificial diet is shown in Table 1.

IV. SILK AND TEXTILE OF *A. YAMAMAI*

Silk fibers of *A. yamamai* are characterized by several superior natures, such as graceful gloss, thick size of fiber, large elongation rate, and stain abilities. The textiles woven by this silk are also characterized with strong, durability, less wrinkle, and rustic touch. *A. yamamai* silk has a peculiar chemical structure differing from *Bombyx* silk, and the difference of dyeing ability can be studied in fabrics design. Union cloth woven with *A. yamamai* silk and *Bombyx* silk can be elevated their textile quality.

V. REARING OF *A. YAMAMAI*

In Japan, *A. yamamai* is usually reared by the followings. (1) Outdoor rearing : a rearing on growing food plants covered with a sheet of net. (2) Indoor rearing on the cut shoots : a rearing on the cut shoots dipped in water in bottles. (3) Indoor box rearing : a rearing on picked leaves in boxes with a net. The larvae hang down the net, and the faeces and litters fall through the meshes. The larvae can be kept in hygienic environment.

The indoor rearing has some advantages, such as the control of climatic conditions, hygienic environments, selection of suitable food, and regulation of amount of food. The potential abilities for silk production can be drawn out by such improved rearing.

FURTHER PROBLEMS OF *A. YAMAMAI* REARING

To more develop and popularize *A. yamamai* rearing in Japan, following points should be resolved.

(1) Breeding of superior *A. yamamai* strain. (2) Breeding of food plant. (3) Cultivation of food plant. (4) Labor-saving for the rearing. (5) Mass-production of egg. (6) Method for artificial hatching. (7) All the year round rearing.

Table 1. Composition of artificial diets.

Substances	Diets containing food plant leaves		Diets containing no food plant leaves	
	50	(g)	-	(g)
Oak leaf powder	50	(g)	-	(g)
Soybean powder	10		25	
Glucose	10		10	
Vitamin mixture	0.5		1	
Ascorbic acid	1.5		2	
Cellulose powder	7.5		28.8	
Agar powder	20		15	
Milk casein	-		10	
Yeast	-		3	
Salts mixture	-		3	
Citric acid	-		1.5	
B-sitosterol	-		0.2	
Cholin chloride	-		0.2	
Sorbic acid	0.5		0.3	
Water	270		270	

ALTITUDINAL EFFECTS ON DOMESTIC REARING OF OAK TASAR
ANTHRAEA PROYLEI J. SILKWORMS IN WESTERN HIMALAYAS

EFFETS DE L'ALTITUDE SUR L'ELEVAGE DOMESTIQUE DU VER A SOIE DU
CHÊNE (TASAR) ANTHRAEA PROLEY J. DANS L'OUEST HIMALAYEN

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In recent years, it has been possible to rear oak-tasar silk-worm, Antheraea proylei Jolly, domestically in western Himalayas. The results of rearing at different altitudes are reported here. At low altitudes (600-1000 m ASL), Quercus incana Roxb. was utilized, which provided around 30 cocoons per laying from the brushings undertaken during early spring season. At middle altitudes (1000-2000 m ASL), rearings were conducted on Q. dilatata Lindley, Q. pedunculata Ehrh., Q. cerris Linn., and Q. palustris Muench, where 25 cocoons per laying could be harvested from the brushings of middle April and early May. Rearing at high altitudes (2000-3500 m ASL) carried on Q. semicarpifolia Smith, gave the best yield of around 60 cocoons per laying from the brushings of ending May and early June.

Further, only one crop of oak tasar cocoons could be harvested from one species of Quercus growing at a particular altitude. It was difficult to rear second brood at the same altitude on the same host plant. However, it has been found in this study that after conducting first brood rearing at low altitude, second brood rearing on Q. semicarpifolia also led to considerable improvement in cocoon and shell weight.

Le ver à soie du chêne, Antheraea proylei Jolly a été élevé récemment de manière domestique dans l'ouest de l'Himalaya. Cet article donne les résultats obtenus avec des élevages effectués à différentes altitudes. Quercus incana Roxb. qui pousse à basse altitude (600-1000 m ASL) a donné environ 30 cocons par ponte à partir des levées du début du printemps. Quercus dilatata Lindley, Q. pedunculata Ehrh., Q. cerris Linn. et Q. palustris Muench, utilisés pour des élevages en altitude moyenne (1000-2000 m ASL) ont donné 25 cocons par ponte à partir des levées de mi-avril et du début du mois de mai. Les élevages effectués

à haute altitude (2000-3500 m ASL) nourris avec *Q. semicarpifolia* Smith ont donné les meilleurs résultats : 60 cocons par ponte à partir des levées de la fin du mois de mai et du début du mois de juin.

Une seule récolte de cocons tassar du chêne a pu être faite à partir d'une espèce de *Quercus* poussant à une altitude particulière. L'élevage de la deuxième génération effectué à la même altitude et sur la même plante nourricière fut difficile. Cependant, cette étude nous a permis de découvrir que lorsque la première génération est élevée à basse altitude, la deuxième génération peut être élevée à haute altitude. L'élevage sur *Q. semicarpifolia* à haute altitude améliore considérablement les poids du cocon et de la coque.

INTRODUCTION

Oak trees are abundantly found at different altitudes in the Himalayan region of this country, extending from Kashmir to Arunachal Pradesh. The distribution of different kinds of oak varies in the western and the eastern hills, depending upon the climate of the particular range. The Indian insect, *Antheraea roylei* Moore inhabits the Himalayas, feeding on various oak, *Quercus* sp. The cocoons of this insect are not commercially utilized due to their double shell and very little quantity of reelable fibre. When Indian female moth of *A. roylei* Moore was crossed with male moth of Chinese *A. pernyi* C.M., a fertile hybrid was obtained named as *A. proylei* Jolly (Jolly et al., 1969). Successive generations of this inter-specific hybrid is nowadays the main oak tassar insect in India.

In the north-eastern states, the rearing is carried outdoor, and till today, it has not been possible to domesticate *A. proylei* J. in that region. But the same insect is reared domestically in the western Himalayas, covering Jammu and Kashmir, Himachal Pradesh, and Western Uttar Pradesh. In this context, it is reported here that inspite of complete indoor rearing of *A. proylei* J. in the western Himalayas, the recovery of cocoons depends upon the altitude of the rearing site and the host plant employed.

MATERIAL AND METHODS

This work was undertaken in Himachal Pradesh, where oak trees grow gregariously on fairly extensive areas in well defined altitudinal zones. Singh (1973) has summarized the area of oak trees in fifteen forest divisions of Himachal Pradesh. In this state, the forests of *Quercus incana* Roxb. grow generally between an altitude of about 1200 and 2500 metres but occasionally it descends down to lower elevations in moist localities, as in Shahpur range of Kangra forest division, where it grows at an elevation of about 600 metres only. In the upper reaches of its natural distribution, *Q. incana* Roxb., gets mixed with *Q. dilatata* Lindley and *Q. semicarpifolia* Smith. *Q. dilatata* Lindley grows in the zone between 1525-2745 metres. *Q. semicarpifolia* is the high level west Himalayan oak and occurs between an elevation of about 2800 and 3500 metres. It descends occasionally to about 2000 metres elevation but is seldom found in sizeable blocks below an elevation of 2500 metres.

Q. pedunculata Ehrh., *Q. cerris*, L., and *Q. palustris* Muenchh are cultivated in an arboratum at Manali at an elevation of 1982 metres.

Antheraea proylei J. has been employed as the oak tasar insect in this study. Freshly prepared disease free layings were incubated for brushing at different elevations. The rearings were conducted completely indoor in the houses locally available. The worms were fed upon the cut twigs of oak trees, twice or thrice a day depending upon the rate of consumption by the worms under rearing.

RESULTS

In order to assess altitudinal effects on domestic rearing, Himachal Pradesh was discriminated in three distinct portions.

I - Range of low altitude (600 - 1000 metres ASL).

II - Range of middle altitude (1000 - 2000 metres ASL) and

III - Range of high altitude (2000 - 3500 metres ASL).

Results of rearing of *A. proylei* J., conducted at different elevations during the years 1981-1983 are summarized in Table 1.

Rearing at low altitude (600 - 1000 metres ASL).

Q. incana Roxb. was utilized at low altitudes. In this study, Shahpur (823 metres) was chosen as a representative for low altitude range, and different batches were compared for their yield. Sprouting of new leaves occurred first of all in this range. It was seen that the brushings undertaken on newly sprouted leaves in early spring period (ending February), provide around 30 cocoons per laying with approximately 59% effective rate of rearing. Delayed brushing undertaken in middle March suffered and only around 10 cocoons per laying could be harvested. No successful crop could be harvested, when brushings were undertaken during summer (ending May).

For autumn rearings, the trees were defoliated during summer and new flush of leaves was utilized. Brushings of middle September gave a yield of only 6 cocoons per laying and it was not possible to get any yield from October brushing. Thus, only one successful crop could be obtained from low altitude area, and that too when brushings were taken up in early season.

Rearing at middle altitude (1000 - 2000 metres ASL).

Rearings conducted at Manali (1982 metres ASL) were considered as representative of middle altitude range. Generally, new leaves sprouted during middle April at Manali. Rearings were carried not only upon naturally growing *Q. dilatata* Lindley, but also upon cultivated *Q. pedunculata* Ehrh., *Q. cerris* L., and *Q. palustris* Muench. It can be seen that maximum effective rate of rearing was achieved at middle altitude on *Q. dilatata* Lindley followed by *Q. palustris* Muench, *Q. cerris* L., and *Q. pedunculata* Ehrh. It was not possible to harvest any cocoon from the brushings of ending May and early August.

Rearing at high altitude (2000 - 3500 metres ASL).

The rearings carried at Winch Camp (2470 metres ASL) were representative of high altitude, where *Q. semicarpifolia* Smith grows naturally. Sprouting of new leaves occurred in *Q. semicarpifolia* Smith at Winch Camp during ending May. The layings prepared from the preponed first crop of low altitude were brushed on *Q. semicarpifolia* Smith at high altitude. Winch Camp results show that the brushings of ending May gave

best yield of around 60 cocoons per laying. Early June brushing also gave a yield of around 54 cocoons per laying but middle June and early July brushings gave a yield of around 37 and 31 cocoons per laying respectively. Late brushings during the end of July at high altitude could not give any harvest.

Q. semicarpifolia Smith does not grow below 2000 metres, but in order to see the effect of high altitude, the rearing of high altitude was compared by arranging *Q. semicarpifolia* Smith at middle altitude (Bir = 1678 metres). It can be seen from Table 3 that remarkable differences were observed in yield when the layings of the same stock (DFL's prepared from the preponed first crop of Shahpur), were reared at two different elevations. While only 25% effective rate of rearing was obtained at 1678 metres (Bir), the same batch reaped 95% E.R.R. at 2470 metres (Winch Camp). This clearly established the effect of high altitude on rearing of *A. proylei* J. on *Q. semicarpifolia* Smith.

DISCUSSION

Antheraea proylei J. has been considered to be more adapted to outdoor growth, as in north-eastern states the rearings are carried outdoor. But in Western Himalayas it is shown that good growth of larvae can be obtained by indoor rearing also.

As compared with mulberry, oak trees are slow growing with low regenerating ability after cutting and their leaves are liable to become hard, and less nutritive. In this study, it is shown that only one successful crop can be harvested from a particular altitude.

A. proylei J. mainly exhibits bivoltine character but it has been difficult to rear a second breed at the same altitude. This has been one of the main problems of the area since the cocoons from the second breed were used as seed during the next spring and its failure led to an extreme scarcity of seed cocoons. Through this work, it has been found that after conducting preponed first crop at low altitude on *Q. incana* Roxb., a second crop rearing could be successfully carried out at high altitudes on *Q. semicarpifolia* Smith. High altitude rearing on *Quercus semicarpifolia* also led to considerable improvement in cocoon and shell weight.

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Sl.	Place of rearing	Altitude (ASL)	Host plant	Period of brushing	No. of cocoons harvested	E.R.R. (%)	Yield/laying
1	Shahpur	823 m	<u>Q. incana</u> Roxb.	a) Ending February	23 887	59	31
				b) Middle March	8 180	54	10
				c) Ending May	Nil	00	00
				d) Middle Sept.	1 165	12	06
				e) Early Oct.	Nil	00	00
2	Manali	1982 m	<u>Q. dilatata</u> Lindley	a) Middle April	2 065	54	25
				b) Early March	957	85	25
				c) Ending May	Nil	00	00
				d) Early August	Nil	00	00
3	Winch Camp	2470 m	<u>Q. semicarpifolia</u> Smith	a) Ending May	28 798	97	60
				b) Early June	15 180	97	54
				c) Middle June	4 000	95	37
				d) Early July	15 040	65	31
				e) Ending July	Nil	00	00

Table 1. Effect of altitude on rearing of *Antheraea proylei* J. in Himachal Pradesh during the year 1981-1983.

Sl. No.	Host plant	No. of crops taken	Place of rearing	No. of dfls. brushed	Av. hatching (%)	Av. larval period in days	Av. wt. of ten mature larvae (gm)	YIELD			COCOON ASSESSMENT		
								Total no. of cocoons harvested	E.R.R. (%)	Yield/ laying	Av. cocoon wt. (g)	Av. shell wt. (g)	Av. shell ratio (%)
1	<u>Q. incana</u> Roxb.	3	Shahpur	2220	49	45	140	34912	51	1:16	5.69	0.55	9.66
2	<u>Q. dilatata</u> Lindley	3	Manali	165	35	45	130	3789	80	1:23	5.83	0.59	10.12
3	<u>Q. pedunculata</u> Ehrh.	3	Manali	43	25	47	130	451	53	1:10	6.33	0.66	10.42
4	<u>Q. cerris</u> Linn	4	Manali	103	34	46	127	1895	70	1:18	6.79	0.66	9.72
5	<u>Q. palustris</u> Muenchh.	3	Manali	27	26	44	123	323	74	1:12	6.15	0.62	10.08
6	<u>Q. semicarpifolia</u> Smith.	2	Winch Camp	2031	51	55	160	81459	71	1:40	7.19	0.77	10.70

Table 2. Rearing performance of *Antheraea proylei* on different *querous* L. during 1981-1983.

Sl. No.	Location	No. of dfls. brushed	Date of brushing	Hatching (%)	Larval period in days	No. of cocoons harvested	E.R.R. (%)	Yield/ laying
1	Winch camp 2470 m ASL	201	27.5.1982	55	52	11470	95	57
2	Bir 1678 m ASL	68	27.5.1982	69	45	1009	25	15

Table 3. A comparative rearing performance of *Antheraea proylei* on *Q. semicarpifolia* Smith at two different altitudes.

STUDIES ON THE TAXONOMY AND FLORAL BIOLOGY OF SOM
(MACHILUS BOMBYCINA KIND) (LAURALES: LAURACEAE)

ETUDE DE LA TAXONOMIE ET DE LA BIOLOGIE FLORALE DU SOM
(MACHILUS BOMBYCINA KIND) (LAURALES : LAURACEAE)

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Some informations on the morphology and floral biology involving opening time of flowers, opening and closing behaviour of tepals, dehiscence of anthers, viability of pollen grains and receptivity of the stigma are reported. The inflorescence is panicle. Flowering starts from last week of November and continues upto middle of March. The maximum anthesis is recorded at 1 p.m. when temperature and humidity of the day are at maximum and minimum respectively. Pollen fertility recorded is 91.8%. Receptivity of the stigma remained from 52 to 150 minutes after opening of inner tepals.

Des renseignements sont donnés sur la morphologie et la biologie des fleurs concernant la durée de l'épanouissement des fleurs, le comportement d'ouverture et de fermeture des tépales, la déhiscence des anthères, la viabilité des grains de pollen et la réceptivité des stigmates. L'inflorescence est paniculée. La floraison débute la dernière semaine de novembre et se poursuit jusqu'à la mi-mars. L'anthèse maximale est enregistrée à 13 h lorsque la température est la plus élevée, et l'humidité la plus faible. La fertilité du pollen est de 91,8 %. La réceptivité des stigmates dure de 52 à 150 minutes après l'ouverture des tépales intérieurs.

INTRODUCTION

Som (*Machilus bombycina* King) is a primary food plant of muga silkworm (*Anthe-raea assama* Westw.). It is distributed in the lower Himalayan region prevalantly in the Brahmaputra valley, Khashi-Jaiyantia hills and Naga hills upto an altitude of 1500 ft. The biology of som is so far not studied in detail and hence, studies were conducted to collect informations on its taxonomy and floral biology which are pre-requisite aspects for breeding and genetic improvements.

MATERIALS AND METHODS

The studies were conducted during the years 1983-84 using two year old trees of som propagated by layerage at Regional Muga Research Station, Field Laboratory, Boko, South Kamrup, district, Assam. The trees were kept under uniform condition of manuring and other cultural operations.

OBSERVATIONS - TAXONOMY

Som is a large, erect growing, parennial evergreen tree, attaining about 20 meters height at maturity.

Root : Deep tap root system.

Stem : Cylindriced, woody, bark grey in colour, rough. Tender stem varies in colour, green, reddish green, red and light red depending upon morphotypes.

Leaves : simple, extipulate, petiolate, alternate, sixth leaf stand over the first one, upper surface smooth, beneath covered with small simple hairs, hairs are prominent over the mid rib, reticulate, pinnate, acute or obtuse, entire, lanceolate or elliptical, leaf length and breadth varies in different morphotypes (Belpatia, Kothalpatia, Naharpatia and Ampatia). Average length 9.28 cm, 14.50 cm, 12.08 cm and 14.65 cm in Belpatia, Kathalpatia, Naharpatia and Ampatia respectively. Average breadth is 3.68, 6.53, 3.20 and 5.04 cm in Belpatia, Kathalpatia, Naharpatia and Ampatia respectively, with 2.49, 2.22, 3.76 and 2.9 cms length-breadth ratio, respectively, lateral measure 17.31, 18.82, 18.49 and 19.11 cm in Belpatia, Kathalpatia, Naharpatia and Ampatia respectively. Petiole length also varies in the different varieties, viz. 0.78, 1.06, 1.50 and 1.54 cm in Belpatia, Kathalpatia, Naharpatia and Ampatia, respectively.

Inflorescence : A panicle, covered with bracts like involucre in bud stage. Bracts 30.4 in number, green in colour are slightly united at the base, inner bracts are bigger in size than the outer. Mean length and breadth of floral bud are 2.40 and 1.39 cm, respectively. On an average, 6.10 number of branches bear flowers peduncles covered with silky hairs.

Flower : Hermaphrodite, hypogynous, pedicellate regular, small, yellow in colour, 10-11 mm long, pedicel length 4-6 mm.

Perianth : Tepals 6, persistant, imbricate in bud, arranged in 2 whorls, outer whorl small in width, outer surface covered with fine silky hairs, outer tepals 5 mm in length and 1.5 mm in breadth, while the inner tepals are 5 mm in length and 2.0-2.5 mm in breadth.

Androeium : Stamens 12 in number are arranged in 4 whorls. Perfect stamens are 9 (3 opposite to outer tepals), 3 opposite to inner tepals; but these 6 are introse, 3 opposite to outer tepals, + stamens, are extross) the inner three sterile stamens are opposite to inner tepals. Glands are 6 in number. Stamens are 4 celled, with fi-

lament hairy at the base, length 1.5 mm-2 mm, anther 1.0-1.5 mm in length and 0.75 mm in breadth, anthers adnate, opening by a valve from below to upwards, staminodes cordate, with rudimentary stalk-hairy at the base.

Gynoecium : Unicarpellary, unilocular with single anatropous pendulous ovule, style terminal 1.5 mm, ovary about 1.0 mm, stigma white wooly just after anthesis, ovary superior with marginal placentation.

Fruit : A fleshy berry, globose, 6 mm to 7.5 mm in across, surrounded by the base of the perianth tube and supported by a thick pedicel.

Seed : Exalbuminous, filled with large straight embryo with a pair of plano-convex cotyledons. Testa membranous. Radicle minute, superior.

Flowering : Last week of November to March.

Fruting : Middle of March to May.

Floral formula : $1.0 \overset{P}{+} 3+3+3+3 \text{ staminodes } \overset{G}{-} 1$

FLORAL BIOLOGY

Inflorescence : the inflorescence appears in the month of November. The terminal bud of each branch terminates into floral bud. Floral buds also originate directly from the stem part. Each floral bud is a complete inflorescence which is a compound raceme or panicle. Sometimes the terminal of most part of the axis of each branch converts into vegetative part bearing new leaves and the reproductive part bearing peduncles with flower buds becomes lateral in origin. Also sometimes the whole apical bud becomes reproductive part bearing peduncles and flowers. The apical bud ceases its activity after the reproductive structure is initiated, an expression of determination of the type of growth. The elongated main axis is branched and lateral branches bear the flowers. The main axis along with lateral axis, known as peduncles are of different length and have different numbers of flowers attached by means of small pedicule. This type of inflorescence is known as panicle or compound raceme.

The mean number of floral buds per tree is 69.70 (± 15.57). Each floral bud is pear shape in structure, covered with involucre of bracts. The length and breadth of each floral bud differ in the different plants which converts into reproductive cum vegetative parts after emergence were rather bigger in length and breadth as compared to the floral bud which bears only the peduncles and flowers. The average length of the floral bud is 2.40 cm and 1.39 cm (average of 90 buds). The average length and breadth of bracts (outer, middle and inner) of involucre is 5.0 mm and 5.8 mm respectively. Bracts are greenish brown in colours, outer surface is hairy while inner concave surface is totally smooth.

The average number of peduncles/floral bud is 6.10 (± 0.36).

The total number of flowerbuds/inflorescence is 86.47 (± 18.03).

The calculated average number of flower buds/peduncle is 14.18.

The first flower bud blooms after 6-7 days of its emergence from bracts of involucre of the floral bud.

Each inflorescence or floral bud is attached with a stalk covered with silky hairs.

Each floral bud measures 22.12 mm (± 0.66 mm) in length and 5.94 mm (± 0.62 in breadth (Table 1).

The average increase in the length and breadth of floral bud during last 10 days before maturity recorded is 1.52 mm and 0.18 mm respectively (Table 2).

The first floral bud emerged in the last week of November and emergence of floral bud continues up to March. The time required for a bud to open completely from date of emergence varies from 6-7 days.

Anthesis : Anthesis starts at 7 hrs and continues upto 17 hrs. The phenomenon is associated with temperature, relative humidity and photoperiod.

Opening and closing behaviour of tepals : Data presented in Table 3 reveal that the outer 3 tepals open first and close later while the inner 3 tepals open later and close first. The outer tepals take 1 hr. 22 min. for opening and 1 hr. 07 min. for closing or setting back, while the inner 3 tepals take 1 hr. 12 min. and 1 hr. 09 min. on an average for opening and closing respectively. The flower remains under full bloomed condition for a very short period (1 hr. 35 min.) and then it sets back to its original condition.

Anthesis in relation to climatic factors : Data presented in table 4 reveal that opening and closing behaviour of som flower is associated with temperature. The maximum blooming of flowers (39.64 %) takes place at 13 hr. at 77.17°F. Hence, the process of anthesis increases with increase in temperature and decrease in temperature. There is no anthesis after 17 hrs and before 5 hr. It is also evident that maximum anthesis (39.64 %) is at lowest R.H. % of the day and the minimum anthesis (1.40 %) is at highest R.H. 89.17 % of the day between 7 hr. to 17 hrs.

Apart from temperature and relative humidity photoperiod also plays a vital role for blooming of flowers. The average photoperiod during the experimentation was 7 hr 5 minutes. In fact, anthesis starts after sunrise and increase upto 13 hrs and the onwards decreases slowly with the sunset is almost negligible. After sunset and before sunrise the buds never bloom (Table 4).

Process of anthesis is greatly affected due to cloudy weather and rain. Cloudy weather and rain result in sudden fall of temperature. Under such circumstances, the unbloomed buds do not bloom while the bloomed buds set back to original condition. These two types of buds are hardly distinguishable under such conditions. The bloomed flowers which set back due to unfavourable weather never bloom again. However, the incompletely bloomed flowers which set back due to unfavourable conditions bloom again on the following day. Thus it is seen that climatic factors viz. temperature, relative humidity, photoperiod, cloud and rain influence greatly anthesis in som.

Dehiscence of Anther : About 30 flower buds were tagged and were examined just after opening of the inner tepals. All the anthers do not dehiscence at the same time, but it starts soon after opening of the inner tepals. The dehiscence of the anther is by a valve from below to upwards, probably due to effect of humidity, temperature or the internal pressure of the pollengrains. Dehiscence starts from 8 hrs and continues up to 15 hrs. The time taken by a flower to vacate all the pollen chambers of 9 stamens varies from 30 minutes to 4 hrs 39 minutes. Dehiscence was maximum between 12 hrs to 14 hrs. Some flowers after blooming set back again to debloomed condition without any dehiscence at 5 p.m. and such flowers bloom again on the next day to complete the dehiscence. At the time of anthesis anthers were grey to brown in colour. Dehiscence of anthers was not recorded before 8 hrs and after 16 hours.

Pollen grains are powdery when the anther bursts and vacate the pollen sacs, pollen grains are of spherical shape and possess coats on the exine and intine. Studies on germination of pollen grains is under progress. Pollen size is 25.

Pollen fertility : The pollen fertility was determined by stainability test of pollen grains with acetocarmine solution. Those pollen grains stained deeply and looked normal were regarded as fertile while shrivelled and weakly stained as sterile. Several fields all over the slide were counted making a total of about 500. Re-counting of the same field was avoided. Percentage of the fertile pollen grains recorded was 91.8 (± 7.66 %).

Receptivity of the stigma : For studying the receptivity, stigmas were examined with the help of hand lens. After the opening of tepals stigma of the flower was white woolly and sticky which indicated the receptivity of the stigma. Gradually the stigma became dull violet which turned black indicating the loss of receptivity. It took 52 minutes to 2 hr. 30 minutes to turn black from white colour. The flowers set back when the stigmatic surface became black.

Fruit formation and fruit setting : Ripening of fruits is completed after 60 days from fertilization. The colour of unripened fruit was green and after ripening it became brown globose, fleshy, 6 mm to 7.5 mm in across, surrounded by the base of the perianth tube and supported by a thick pedicel.

Seed is exalbuminous, filled with large straight planoconvex cotyledons. Testa, membranous, radicle minute, superior seed 0.4 to 0.80 cm in breadth, slightly broader than longer. The seed colour is grey brown with irregular black bands on the body. Average weight is 0.22 g.

DISCUSSIONS

Studies on the flowering behaviour, blooming duration, blooming period, anthesis dehiscence of anther, pollen fertility and receptivity of the stigma indicate seasonal influence and diurnal rhythm, and these activities are precisely timed by intrinsic physiological activities. Flowers of peduncles open first than axillary ones. In South-Kamrup condition (Assam), flowering in som started from last week of November and continued to middle of March. Anthesis studies in som indicate that temperature has some influence on anthesis, as the percentage of anthesis increased with rise in temperature. Maximum anthesis took place during mid-noon at 1 p.m. and the rate of anthesis decreased afterwards. Dehiscence of anthers is maximum between 12 hrs to 14 hrs. Studies on the pollen fertility show that som had 91.8 % fertile pollen.

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Replication No.	Length $\bar{x}$ (mm)	Breadth $\bar{x}$ (mm)
R	22.00	6.00
R	21.25	5.75
R	22.75	5.25
R	22.50	6.75
Total	88.50	23.75
Mean	22.12	5.94
S.D. $\pm$	± 0.66	± 0.62

Table 1. Size of the inflorescence of som (*Machilus bombycina*) at maturity.

Replication No.	Increase in length after 10 days $\bar{x}$ (mm)	Increase in the breadth after 10 days ($\bar{x}$ mm)
1	16.20	1.80
2	14.00	2.00
3	13.60	1.70
4	17.00	1.70
Total	68.80	7.20
Mean	15.20	1.80

Calculated increase in length/day and breadth/day are 1.5 mm and 0.18 mm respectively.

Table 2. Growth pattern of floral bud of som (*M. bombycina*) during the last 10 days of maturity.

Sl No.	Time of opening of outer tepals (hrs.)	Time taken (hrs.)	Time of opening of inner tepals (hrs.)	Time taken (hrs.)	Time of closing of outer tepals (hrs.)	Time taken (hrs.)	Time of closing inner tepals (hrs.)	Time taken (hrs.)	Duration of full bloom (hrs.)
1	07.30 - 08.40	1.10	07.48 - 08.50	1.02	10.05 - 11.19	1.14	10.00 - 11.06	1.06	1.10
2	08.00 - 09.14	1.14	08.14 - 09.26	1.12	10.40 - 11.54	1.14	10.30 - 11.38	1.08	1.04
3	08.20 - 09.35	1.15	08.25 - 09.47	1.12	10.58 - 12.11	1.13	10.52 - 12.04	1.12	1.05
4	09.00 - 10.14	1.14	09.13 - 10.27	1.14	11.55 - 12.57	1.02	11.40 - 12.50	1.10	1.17
5	09.05 - 10.20	1.15	09.18 - 10.33	1.15	12.03 - 13.03	1.00	11.48 - 12.54	1.06	1.15
6	09.15 - 10.29	1.16	09.25 - 10.41	1.16	12.09 - 13.15	1.06	11.54 - 13.04	1.10	1.13
7	10.40 - 11.56	1.14	10.50 - 12.05	1.15	13.40 - 14.48	1.08	13.32 - 14.40	1.08	1.27
8	11.00 - 12.14	1.15	11.10 - 12.23	1.13	15.00 - 16.05	1.05	14.45 - 16.00	1.15	2.22
9	11.02 - 12.17	1.15	11.13 - 12.26	1.13	15.16 - 16.20	1.04	15.05 - 16.12	1.07	2.39
10	11.35 - 12.50	1.15	11.45 - 12.57	1.12	15.20 - 16.27	1.07	15.10 - 16.25	1.15	2.13
Total		12.12		12.4		11.13		11.37	
Average		1-22.2		1-12.4		1-7.3		1-9.7	

The observations were made on the terminal buds which open first. However, there is no difference in blooming of terminal and axillary flower buds.

Table 3. Opening behaviour of floral bud of som (*Machilus bombycina*) during different hours of day.

Date of Observation	7 A.M.	9 A.M.	11 A.M.	1 P.M.	3 P.M.	5 P.M.	Photoperiod
21.12.83	0	4.41	16.18	50.00	20.59	8.82	9 hr 35 minutes
22.12.83	0.79	1.59	20.63	47.62	21.43	7.94	8 hr 40 minutes
23.12.83	6.33	8.86	27.85	43.04	10.12	3.80	10 hr 0 minute
24.12.83	0	7.69	65.38	17.31	9.62	0	7 hr 5 minutes
25.12.83	1.30	5.23	26.80	39.87	21.57	5.23	7 hr 10 minutes
26.12.83	0	28.18	18.80	40.00	13.64	0	Total cloudy day.
Total	8.40	55.96	175.02	237.84	96.97	25.77	41 hr 90 minutes or 42 hr 30 minutes
Average	1.40	9.33	29.17	39.64	16.16	4.30	7 hr 5 minutes
Mean temp. (°F)	59.92	60.75	66.67	77.17	69.67	66.32	
Mean R.H. (%)	89.17	76.83	65.83	62.17	64.50	82.83	

Table 4. Anthesis in som (*Machilus bombycina*) during different hours (in %).

STUDIES ON NATURAL POPULATION OF ANTHRAEA ASSAMA WESTW.
(SATURNIIDAE : LEPIDOPTERA)

ETUDE DE LA POPULATION NATURELLE DE ANTHRAEA ASSAMA WESTW.
(SATURNIIDAE : LEPIDOPTERA)

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The natural population of Antheraea assama Westwood exhibits genetic diversity in respect of egg, larval and cocoon characters. The different wild strains have greater shell ratio and fecundity than the common green larval forms. Also, a small portion of the natural population experiences diapause during the pupal stage which may represent a 'fail-safe' device. The genetic diversity offers scope for exploitation of hybrid vigour.

La population naturelle de Antheraea assama Westwood montre une diversité sur le plan génétique en ce qui concerne les caractères de l'oeuf de la larve et du cocon. Les différentes souches sauvages ont une richesse soyeuse et une fécondité plus élevées que chez les formes communes à larves vertes. Une petite partie de la population se met en diapause pendant la nymphose ce qui représente peut-être un "dispositif de sécurité". La diversité génétique offre un large champ d'exploitation pour l'hybridation.

INTRODUCTION

Natural populations are a valuable source for genetical studies as they often exhibit great diversity among their individuals. Occurrence of variants or genetic strains is a common phenomenon among insects (Verley *et al.*, 1973). Sericigenous species viz. *Bombyx mori* L. (mulberry silkworm), *Antheraea mylitta* Drury (tasar) and *Phylosamia ricini* Hutt. (eri) exhibit great diversity. In *B. mori*, a large number of conspicuous variants based on larval colour, shape, size and colour of eggs and cocoons, and voltinism have been recorded (Chowdhury, 1965). In *A. mylitta*, the normal larva is green in colour but yellow, blue and almond colour-morphs (Jolly *et al.*, 1967 a,b, 1969, 1970) and also variants as regards to peduncular length, size and shape of cocoons and number of moulting in larvae have been recorded in the natural population (Jolly *et al.*, 1974). Narasimhanna (1967) observed colour variants in the larvae of *P. ricini*. The occurrence of variants in these silkworms have offered a good scope for exploitation of hybrid vigour. In muga silkworm (*Antheraea assama* W.), there are sporadic mention about the occurrence of variants in natural population. Chowdhury (1974, 1981) recorded yellow, blue and bright orange colour larvae amongst the usual green larvae. However, these colour-morphs were subsequently reported to be extinct (Chowdhury, 1981, Subba Rao, 1983). Besides the colour-morphs, the muga silkworm is also reported to have distinct strains as regards to voltinism. They are usually multivoltine having 5-6 generations in a year. But certain wild strains in the natural habitat undergo hibernation during the pupal stage in the winter season (Chowdhury, 1962, 1981). However, systematic study has not been made on the biology and inheritance pattern of these characters in the wild strains. Therefore, a survey was made among the natural population of *A. assama* for collection and detail study of natural variants.

MATERIALS AND METHODS

An intensive survey was made during March 1982 to January 1984 for collecting wild strains in the hilly tracts around Sibsagar, Dibrugarh and South-Kamrup districts of Assam, East and West Garo hills of Meghalaya, and Tirap and Dibang valley districts of Arunachal Pradesh. Also, the muga rearings of private rearers in these places were surveyed to observe any conspicuous variation in the natural population of larvae. Any notable variant collected during the survey was brought to the laboratory for close examination and isolation of homozygous forms.

OBSERVATIONS AND RESULTS

During the course of the survey six wild strains based on cocoon characters, voltinism and structure of eggs, and three different larval colour-morphs were collected. The salient characters of these forms (Table 1) are described below.

WILD STRAINS

- Type A :

This was collected from the Sotai hills, bordering Sibsagar district of Assam and Tirap district of Arunachal Pradesh. The larvae were feeding on som (*Machilus bombycina* King) trees wildly growing in the forests. The average weight of one full grown male and female larva was 15.2 g and 19.5 g respectively. The cocoons were irregularly oval in shape (Fig. 1) in comparison to the oval shape in the normal type (Fig. 2). The average weight of male and female cocoons were 5.7 g and 7.8 g the shell ratio being 12.7 % and 9.8 % respectively. The pupal period under the normal conditions in winter was 20 days. A fecundated female moth laid 91.9 % of its total egg laying potency (470 eggs). The larvae are vigorous and feed voraciously.

- Type B :

The larvae of this type were collected from wild som plants in Rotonpuria area of Sibsagar. The mature larva had an average weight of 15.59 g (male) and 20.2 g (female). The cocoon weight and the shell ratio were as follows : male 5.9 g and 15.9 % and female 7.6 g and 12.5 % respectively. Pupal period under normal laboratory conditions in winter was 19 days. The average egg laying capacity of a female moth was 462 eggs, and the fecundity was 83.5 %. The most striking feature of this wild strain was the elongated shape of cocoons having distinct horizontal depressions on the surface (Fig. 3). Like wild type-A, the larvae of this type also feed voraciously.

- Type C :

Collected from the wild som plants in the Mantonia area of Sibsagar district, the weight of male and larvae were 13.1 g and 17.1 g respectively. The cocoon weight and the shell ratio were 4.9 g and 13.8 % respectively, in the males. In case of females, the corresponding values were 6.8 g and 10.5 %. The cocoons were irregularly oval in shape (Fig. 4). The pupal period lasted over 100 days under the normal laboratory conditions in winter.

- Type D :

This was collected from the hills bordering Sibsagar and Tirap district (Arunachal Pradesh). The mature male and female larvae weighed 14.8 g and 18.6 g respectively. The cocoon weight and shell ratio of males were 5.3 g and 12.9 %. The respective values for females were 7.3 g and 8.5 %. The cocoon was irregularly oval in shape (Fig. 5). Pupal period lasted over 100 days under the normal laboratory condition in winter.

- Type E :

The larvae of this type were collected in wild digloti (*Litsaea salicifolia* Roxb.) plants in the hills bordering Sibsagar district and Nagaland. The weight of one fully mature larva was 14.5 g (male) and 18.9 g (female). A male cocoon weighed 5.2 g with 15.5 % shell ratio. The female cocoons weighed 7.5 g and the shell ratio was 10.2 %. The cocoons were irregularly oval in shape (Fig. 6). The pupal period lasted 86 days under the normal laboratory conditions in winter.

- Type F :

This type was collected in the egg stage from underneath the leaves of phutuka (*Melastoma malabathricum*) plants from the Belimkhia forest, Sibsagar. The eggs were conspicuous by their creamish white colour having two distinct brown bands across the middle (Fig. 7). This was in sharp contrast to the normal muga silkworm eggs which are brown in colour (Fig. 8). The larvae of this wild type feed on phutuka and som leaves.

COLOUR-MORPHS

The different colour-morphs reported in this study were collected from the rearings conducted by the local rearers in Sibsagar district. The muga larvae are predominantly green in colour (Fig. 9).

- Yellow-morph :

In most of the yellow-morph, the lateral sides were dark yellow having a greenish tinge on the dorsal side (Fig. 10). But in some, the whole body was dark yellow

in colour (Fig. 11). Unlike that in green larvae, the tubercles in yellow larvae were white in colour till the third larval instar and then onwards it changed to yellow. The tubercle colour of the normal green larvae varies in different larval stages, bluish in the second, purple in the third, brick in the fourth and crimson red in the last instar. The average weight of mature larvae, cocoon wt. and the shell ratio of cocoons in males of yellow-morphs were, 12.9 g, 5.3 g and 9.6 % respectively. The respective values for females were, 16.9 g, 5.5 g and 7.9 %. The pupal period in the normal laboratory conditions in winter was 19 days. The average egg laying capacity was 190 eggs. A fecundated female moth laid 135 eggs (71.05 %).

- Blue-morph :

The blue colour were rare. The mature larvae weighed 18.5 g.

- Orange-morphs :

Like the blue-morphs, the orange colour larvae were also rare. The larvae were however, slightly orange in colour and not bright orange as earlier observed by Chowdhury (1974). A coating of white powdery substance was noticed on the body surface of this colour-morph.

DISCUSSION

The individual members of any outbreeding natural population often show variations in their phenotype and physiological adaptation under different conditions of nutrition, crowding and other factors of the environment (Stebbins, 1973). This is largely due to differences in the genetic component of the individuals comprising the population. Therefore, occurrence of natural variants is indicative of the heterozygous conditions of genetic structure of the population. It has been earlier reported that the muga silkworm population has already reached the peak level of homozygosity (Subba Rao, 1983) as the natural variants no longer occur in natural habitat (Chowdhury, 1981, Subba Rao, 1983). However, the present observations on the occurrence of wild strains and the colour-morphs among the natural population is clearly suggestive of the heterozygous condition of this silkworm offering tremendous scope for commercial exploitation of hybrid vigour.

The wild strains and the colour-morphs observed in the present study have been distinct from the normal type as regards to colour of larvae, structure of eggs and shape of cocoons. The egg laying capacity and the fecundity of the wild types A-B were higher than the normal type (Table 1). Besides these, the pupal period in the wild types G-E extended over three months during the winter season in comparison to only 20 days in the normal type. This indicated the diapausing nature of pupae of these wild strains. The pattern of inheritance of characters and selection process of all the wild strains and colour-morphs are under investigation.

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Strain	Larval wt. (g)		Cocoon wt. (g)		Shell ratio (g)		Egg laying potential in No.	Fecundity (%)	Pupal period No. of days
	M	F	M	F	M	F			
WILD									
Type - A	15.2	19.5	5.7	7.8	12.7	9.8	470	91.91	20
Type - B	15.59	20.5	5.7	7.6	15.9	12.5	462	83.5.	19
Type - C	13.1	17.1	4.9	6.8	13.8	10.5	U.O.	U.O.	100
Type - D	14.8	18.6	5.3	7.9	12.9	8.5	U.O.	U.O.	100
Type - E	14.5	18.9	5.2	7.5	15.5	10.2	U.O.	U.O.	86
Type - F	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.
COULOUR-MORPHS									
Yellow-morph	12.9	16.9	5.3	5.5	9.6	7.9	190	71.05	19
Blue-morph	U.O.	18.5	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.
Orange-morph	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.	U.O.
COMMON STRAIN	12.3	13.8	4.92	5.58	9.15	7.71	178	66.2	20

U.O. : Under observation - M : Male - F : Female.

Table 1. Larval and cocoon characters among different strains of *A. assama*.

USE OF LIFE-TABLES IN THE EVALUATION OF CASTOR VARIETIES
(AS FOOD) FOR THE LARVAE OF ERI SILKWORM PHILOSAMIA RICINI HUTT.
(LEP : SARTURNIIDAE)

UTILISATION DES TABLES DE VIE POUR L'EVALUATION
DES VARIETES DE RICIN DANS L'ALIMENTATION DES LARVES
DU VER A SOIE ERI PHILOSAMIA RICINI HUTT.

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Three experimental life-tables were constructed, each for Eri silkmoth, Philosamia ricini, fed exclusively on one of the three castor varieties (NPH-1, GCH-3 and C-413). The value of life expectancy (ex), net replacement rate (R_0) and innate capacity for increase (r_m) were higher with NPH-1 and GCH-3 than with C-413.

Trois tables de vie expérimentales sont établies pour les vers à soie eri (Philosamia ricini) alimentés avec l'une des trois variétés de ricin suivantes : NPH-1, GCH-3 et C-413. Les valeurs de l'espérance de vie (ex), du taux net de renouvellement (R_0) et de la capacité endogène de croissance (r_m) sont plus élevées lors de l'alimentation avec NPH-1 et GCH-3 qu'avec C-413.

INTRODUCTION

Insect life tables can now be completed to assess the value of various ingredients of the environment. Andrewartha and Birch (1954) stressed that food, as a component of the environment, influences an animal's chance to survive and multiply by modifying its fecundity, longevity and speed of development. Both the quality and quantity of food are important.

In order to judge the relative merit of the castor varieties (NPH-1, GCH-3 and C-413), three life tables were constructed, one for each population of eri silkmoth, *Philosamia ricini*.

This study is part of our exploration to find the best suited variety of castor for introducing sericulture as a new agro-cottage industry in the Indian desert. It is hoped that this introduction would prove to be an energy subsidy in a region, where the largest human and live stock populations per unit area have converted most of the grasslands into agro-ecosystems, creating the heaviest energy drain among the hot deserts of the world.

MATERIAL AND METHODS

From three experiments, started each with hundred eggs of first-day hatchings pooled from layings of four disease free females, life tables have been constructed of populations fed on three castor varieties (NPH-1, GCH-3 and C-413). The temperature in the laboratory ranged between 24°-31°C and RH 45-84%.

In the life table the age category (days) was designated as x , the survival series l_x . The unit survival rate (l_{x+1}) was calculated as a fraction of one. The mortality rate (q_x) was calculated by dx/l_x , where dx indicates the mortality.

The expectancy of life has been computed from national stationary populations (l_x and T_x). Actually all the individuals do not die suddenly at the end of the age class interval as has to be shown in the life table for the purpose of calculations. The mortality continues in a random manner all through the interval, therefore, l_x is visualized as the number of the individuals surviving at the middle point of the class interval, being the average of the survival (l_x) of two successive intervals.

Population is dynamic, because new recruits are entering each of the various age-class intervals constantly, being governed by the potential fecundity of the species. When a number of individuals crosses the age class interval, either by death or by growing older, thus entering the next higher class interval, the place is immediately taken up by another number of individuals who have qualified from the lower class interval. Thus at the upper threshold of the class interval in the T_x , there are not only the numbers shown as l_x , for that class interval, but also the hatch that has passed through this class interval. This national statistic is called T_x , representing the total number of individuals that have lived all the class intervals earlier. This statistic is computed from the bottom of the l_x column upwards, carrying the running cumulative total right to the top. This cumulative total at the top of T_x column represents the population that has lived the entire life span, from which the expectancy of life (e_x) can be computed as the proportion of T_x/l_x (Deevey, 1947).

The net replacement rate (R_0) of the female population on each successive day was determined from the product of the average number of eggs produced (m_x) by the female surviving at that age (l_{x+1}). The summation of the column R_0 gives the total

of the day to day replacement rate of an average female from each generation. This would be the carrying capacity of the average insect under specified environmental conditions, which in the present context is the castor variety.

Innate capacity for increase (r_m) is the only statistic which adequately summarizes the physiological qualities of an animal with respect to its capacity to increase in numbers from moment to moment (Andrewartha and Birch, 1954, p. 43) during one generation times (T) which is mathematically determined by an equation due to Dublin and Lotka (1925):

$$T = \frac{\sum l_x.m_x.x}{\sum l_x.m_x}$$

$$r_m = \frac{\log_e R_0}{T}$$

Potential fecundity (Pf) is the summation of column recording successive natality rate (m_x) of the age specific surviving females (Tables 4-7). This, therefore, gives the total number of eggs laid by a unit female over her life time.

The Annual Biotic Potential was calculated by the following formula:

Annual Biotic Potential (BP) = PZ^n ... Themson (1939), where P is potential fecundity and Z is the number of generations in a year.

RESULTS AND DISCUSSION

Expectancy of life (e_x)

The expectancy of life (Tables 1, 2 & 7) remained almost similar at the time of egg-laying in case of larvae fed on castor variety NPH-1 and GCH-3. In case of larvae fed on variety C-413, however, the expectancy (e_x) was very much lower (37 days) than that of the others (41 days), obviously because of high mortality of the larvae during the feeding period (Fig. 1). This high mortality during feeding stage proves that, nutritionally, castor variety C-413 was inadequate.

It can also be seen that expectancy of eri silkworm decreases continuously (Fig. 1) as the age of moth increases, showing uniform mortality rate. Similar pattern was observed for mountain sheep (Deevey, 1947), gray squirrel (Barkalow *et al.*, 1970) and humans (Ehrlich *et al.*, 1977, p. 13-14). In organisms, where mortality rate is very high during the young stages, the pattern will be different.

Survivorship (l_x)

Since the beginning was made with 100 eggs in each experiment, the sex-ratio (whatever), rates of survival, death and birth can be reasonably assumed to be the result of differences in the castor varieties fed upon by the larvae, when all other environmental conditions were the same.

The survival of adults (l_x) on the completion of pupation shows a range of 63 (NPH-1, Table 2) to 47 (C-413, Table 3), in between which lies the value 60 (GCH-3, Table 1). These figures show that, in matter of survivorship, the castor variety GCH-3 comes only next to the best (NPH-1). In the matter of age specific survival of females (l_{x1} , Tables 4-6) also, the females of GCH-3 (0.23, Table 4) lie between 0.26 (on variety NPH-1) and 0.18 (on variety C-413). Thus, comparing the female sur-

vivorship (lx_1), natality rate (mx) and replacement rate (R_0), it is observed that larger natality rate of 194 eggs per day on GCH-3 (45 eggs per day more than on NPH-1) makes up a great deal for the female survivorship being 3% less and comes close to the moths reared on the best castor variety (NPH-1) in the matter of replacement rate (R_0). Both natality rate and female survival are important considerations in selecting the castor variety for establishing ericulture.

Net replacement rate (R_0)

The net replacement rate explains the total number of female offspring produced by a female during a life time.

The net replacement rate is maximum (96.19) on castor var. NPH-1, minimum (64.47) on var. C-413, and in between these two lies the value of var. GCH-3 (91.69), indicating the maximum population turn over on castor var. NPH-1, followed by var. GCH-3 and var. C-413 in that order. It can be seen that the net replacement rate is maximum on the first day of the oviposition (Tables 4-6) and it reduces successively thereafter.

The decreasing pattern of R_0 with advancement of age of the female is a common phenomenon observed e.g. in rice weevil, *Calendra oryzae* (Birch, 1948), voles, *Microtus agrestis* (Leslie and Ranson, 1940).

Innate capacity for increase (r_m)

This statistic gives instantaneous rate of population increase from moment to moment, which, for facility in comparison, is mathematically computed as the mean period elapsing from birth of the parents to birth of the offspring (T). These values are of the same order (0.1) for NPH-1 and GCH-3, but lower for C-413 (0.09).

Annual biotic potential (BP)

Since the eri silkmoth takes about two months for completion of a generation and there is no fixed breeding season, 5-6 generations per year are possible. It is apparent from Table 7 that the potential fecundity and annual biotic potential are both high when the larvae are reared on castor var. NPH-1, followed by those reared on GCH-3 and C-413, in that order. In conclusion, considering all these parameters, it can be said that among the three varieties, the NPH-1 and GCH-3 are superior to C-413.

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	Age in days	No. of survivors	Fraction survivals	No. dying	Mortality rate	Average alive	Total alive	Life expectancy x class interval
	x	lx	l_x/l_0	dx	qx	lx	Lx	ex
Eggs laid	0	100	1.00	-	-	100	1360	40.8
	3	100	1.00	-	-	100	1260	37.8
	6	100	1.00	-	-	100	1160	34.8
Hatching	9	100	1.00	7	0.07	96.3	1060	31.8
I Instar	12	93	0.93	-	-	96.3	936.5	31.08
II Instar	15	93	0.93	5	0.05	90.5	870.5	28.08
III Instar	18	88	0.88	3	0.03	86.5	780.0	26.58
IV Instar	21	85	0.85	7	0.08	81.5	693.5	24.48
V Instar	24	78	0.78	1	0.01	77.5	612.0	23.55
Prepupa + Pupa	27	77	0.77	-	-	77.0	534.4	20.82
	30	77	0.77	-	-	77.0	457.5	17.82
	33	77	0.77	-	-	77.0	380.5	14.82
Pupa	36	77	0.77	14	0.18	70.0	303.5	11.82
	39	63	0.63	3	0.04	61.5	233.5	11.10
Postpupa + Adult	42	60	0.60	-	-	60.0	172.0	8.61
	45	60	0.60	1	0.01	59.5	112.0	5.58
Adult	48	59	0.59	36	0.61	41.0	52.5	2.67
Adult	51	23	0.23	23	1.00	11.5	11.5	1.50

Table 1. Life table of eri silkmoth, *Philosamia ricini* Hutt.,
when the larvae were reared on castor variety GCH-3.

	Age in days	No. of survivors	Fraction survivals	No. dying	Mortality rate	Average alive	Total alive	Life expectancy x class interval (3)
Eggs laid	0	100	100	-	-	100	1380	41
	3	100	1.00	-	-	100	1280	38.4
	6	100	1.00	-	-	100	1180	35.4
Hatching	9	100	1.00	6.	0.06	97	1080	32.4
I Instar	12	94	0.94	4	0.04	92	983	31.38
II Instar	15	90	0.90	-	-	90	891	29.7
III Instar	18	90	0.90	5	0.05	87.5	801	26.7
IV Instar	21	85	0.85	4	0.04	83.0	713.5	25.17
V Instar	24	81	0.81	-	-	81.0	630.5	23.37
Prepupa + pupa	27	81	0.81	2	0.02	80.0	549.5	20.54
	30	79	0.79	5	0.06	76.5	469.5	17.82
	33	74	0.74	-	-	74.0	399.0	25.93
	36	74	0.74	-	-	74.0	319.0	12.93
Postpupa	39	74	0.74	11	0.15	68.5	245.0	9.93
Adults	42	63	0.63	1	0.01	62.5	176.5	8.40
	45	62	0.62	-	-	62.0	114.0	5.52
	48	62	0.62	41	0.66	41.5	52.0	2.52
	51	21	0.21	21	1.00	10.5	10.5	1.50

Table 2. Life table of Eri silkmoth, *Philosamia ricini* Hutt., when the larvae were reared on castor variety NPH-1

	Age in days	No. of survivors	Fraction survivals	No. dying	Mortality rate	Average alive	Total alive	Life expectancy x class interval (3)
	x	lx	lx ₁	dx	qx	Lx	Tx	ex
Eggs laid	0	100	1.00	-	-	100	1234	37.02
	3	100	1.00	-	-	100	1134	34.02
	6	100	1.00	-	-	100	1034	31.02
Hatching	9	100	1.00	4	0.04	98	934	28.02
I Instar	12	96	0.96	1	0.01	95.5	36	26.10
II Instar	15	95	0.95	7	0.07	91.5	740	23.37
III Instar	18	88	0.88	5	0.05	85.5	649	22.11
IV Instar	21	83	0.83	13	0.15	76.5	563.5	20.37
V Instar	24	70	0.70	7	0.10	66.5	487	20.88
Prepupa + pupa	27	63	0.63	-	-	63	420.5	20.01
	30	63	0.63	5	0.08	60.5	357.5	17.01
Pupa	33	58	0.58	2	0.02	57	297	15.36
	36	56	0.56	2	0.03	55	240	12.84
	39	54	0.55	7	0.13	50.5	185	10.26
Postpupa + adult	42	47	0.47	4	0.08	45	134.5	8.58
	45	43	0.43	-	-	43	89.5	6.24
Adults	48	43	0.43	18	0.42	34	46.5	3.24
	51	25	0.25	25	1.00	12.5	12.5	1.50

Table 3. Life table of the Eri silkmoth, *Philosamia ricini* Hutt., when the larvae were reared on castor variety C-413.

Age in days	Age specific survival rate	Total progeny	Natality rate	Net replacement (reproduction rate)
x	lx_1	mx_1	mx	$R_0 = lx_1 \cdot mx$
44.0	0.23	4462	194	44.62
45.0	0.23	2921	127	29.21
46.0	0.23	1219	053	12.19
47.0	0.21	0378	018	03.78
48.0	0.21	0189	009	01.89
49.0	0.24	-	-	-
50.0	0.05	-	-	-

Potential Fecundity (PF) : 401.

Net Replacement rate $R_0 = 91.69$.

Table 4. Life table and net replacement (reproduction) rate of Eri silkmoth, *Philosamia ricini* when the larvae were reared on castor variety GCH-3

Age in days	Age specific survival rate	Total progeny	Natality rate	Net replacement (Reproduction rate)
x	lx_1	mx_1	mx	$R_0 = lx_1 \cdot mx$
44.05	0.26	3874	149	38.74
45.5	0.26	2522	097	25.22
46.5	0.26	2158	083	21.58
47.5	0.21	0861	041	08.61
48.5	0.17	0204	012	02.04
49.5	0.16	-	-	-
50.5	0.02	-	-	-

Potential fecundity (PF) : 382.

Net replacement rate $R_0 = 96.19$.

Table 5. Life table and net replacement (reproduction) rate of Eri silkmoth, *Philosamia ricini* when the larvae were fed on castor variety NPH-1.

Age in days	Age specific survival rate	Total progeny	Mortality rate	Net replacement (reproduction rate)
44.0	0.18	2664	148	26.64
45.0	0.18	1836	102	18.36
46.0	0.17	1241	073	12.41
47.0	0.17	0378	034	05.78
48.0	0.16	0128	008	01.28
49.0	0.10	-	-	-
50.0	-	-	-	-

Potential fecundity (Pf) = 365.

Net replacement rate $R_0 = 64.47$.

Table 6. Life table and net replacement (reproduction) rate of Eri silkmoth, *Philosamia ricini* when the larvae were reared on castor variety C-413.

Castor variety	Life expectancy	Net replacement rate	Innate capacity for increase	Potential fecundity	Annual biotic potential
	ex	R_0	r_m	Pf	BP
NPH-1	41.4	96.19	0.100	382	49,660
GCH-3	40.8	91.69	0.100	401	46,115
C-413	37.02	64.47	0.093	365	32,850

Table 7. Comparative performance of life expectancy (ex), net replacement rate (R_0), innate capacity for increase (r_m), potential fecundity (Pf), and annual biotic potential (BP) of Eri silkmoth *Philosamia ricini* when the larvae were reared on three castor varieties.

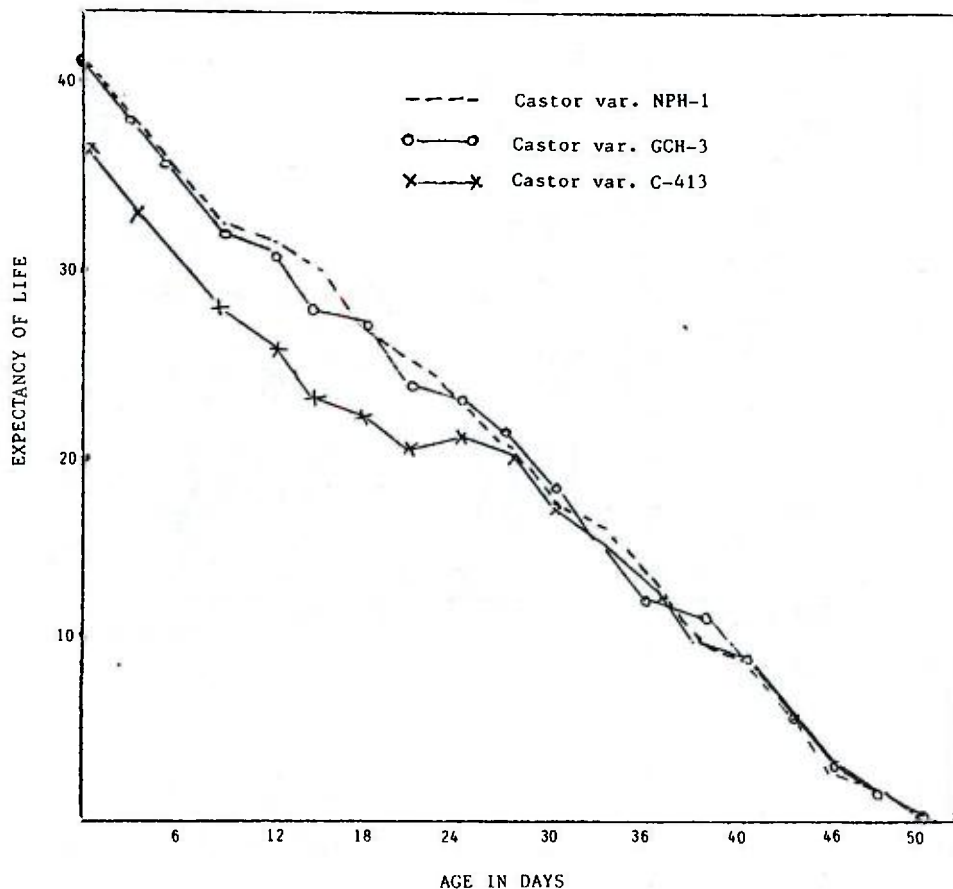


Figure 1. Decline in expectancy of life of eri silkworm *Philosamia ricini* Hutt. (Lepidoptera : Saturniidae)

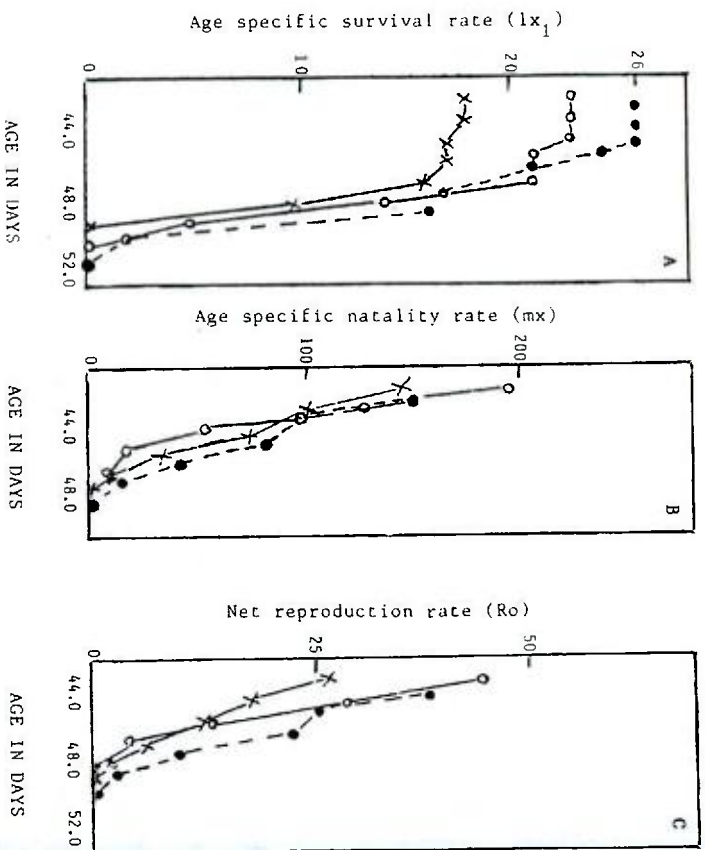


Figure 2. Comparative performance of age specific survival rate (A), age specific natality rate (B), and net reproduction rate (C), when the larvae of eri silkmoth were reared on three castor varieties (NPH-1, GCH-3 and C-413).

NON-MULBERRY SERICULTURE - ITS PROBLEMS AND PROSPECTS

SERICICULTURE NON-MURIER - SES PROBLEMES ET SES PERSPECTIVES

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Cultivation, rearing and extraction of silk in the case of non-mulberry sericulture are beset with a number of problems. The host plants are difficult to propagate and slow growing, number of eggs laid by a mother moth is much less as compared to the mulberry silkworm, the rearing by and large being out-door is subject to climatic hazards like extreme variation of temperature, gale and storms besides free attack of pests and predators. The extraction of silk is also not so easy as in the case of mulberry silkworm, filament length being small in some, others being required to be treated with sodium carbonate, pressurized steam and proteolytic enzyme before being easily reeled. Some of them like eri silk is completely unreelable.

There are however, some advantages too. The host plants are available in plenty in nature grown condition so that one can often do away with private investment on land, rearing and cocoon formation being out-door, labour consumption is much less and one needs not also invest on the construction of rearing rooms, purchase of rearing and cocooning appliances, etc. Reeling processes have also been improved considerably now with a yield upto 450 gms. of silk per basin per man. Trials on improvement in fecundity, indoor rearing on collected branches and artificial diet are also at the threshold of success. Thus, in spite of some current difficulties, the non-mulberry silks with their special characteristics of retaining their sublime colours like light greenish in the case of *Antheraea yamamai*, light creamish in the case of *Antheraea pernyi/proylei*, fawn colour in the case of *Antheraea mylitta* and golden colour in the case of *Antheraea assama* are bound to flourish during the years to come. *Philosamia ricini* (eri) silk with its excellent blending properties with both cotton and synthetics is also looked at as a prospective fibre for the production of various kinds of mixed fabrics.

Dans le cas de la sériciculture non-mûrier, la culture, l'élevage et le dévidage de la soie posent un certain nombre de problèmes. Les plantes nourricières sont difficiles à cultiver et leur croissance est faible. Le nombre d'oeufs par ponte est beaucoup moins élevé que chez les vers à soie mûriers. L'élevage en extérieur est soumis aux changements climatiques tels que les variations de température, la grêle, les orages et les attaques des parasites et prédateurs. Le dévidage de la soie est également moins aisé que chez le ver à soie mûrier car les filaments sont parfois courts ou doivent être traités au carbonate de sodium, à la vapeur sous pression et aux enzymes protéolytiques pour être facilement dévidés. Certaines même, comme la soie eri, ne sont pas dévidables. Il y a cependant un certain nombre d'avantages. Les plantes nourricières se trouvent en grand nombre dans la nature, il n'est donc pas utile de faire des investissements fonciers. L'élevage se faisant en extérieur, la main-d'oeuvre est moins importante et il n'est pas nécessaire d'investir dans la construction de magnaneries ou dans l'achat de matériel d'élevage. Les procédés de dévidage ont été considérablement améliorés avec un rendement allant jusqu'à 450 g de soie par bassine et par homme. Les essais tendant à améliorer la fécondité et à effectuer des élevages en intérieur sur des branches ou sur aliments artificiels sont très concluants. Ainsi, malgré les problèmes, les soies non-mûriers et leur capacités particulières à garder leurs merveilleuses couleurs (vert clair pour les *Antheraea yamamai*, blanc crème pour les *Antheraea pernyi/proylei*, couleur fauve pour les *Antheraea mylitta* et couleur dorée pour les *Antheraea assama*) seront florissantes dans les années à venir. La soie eri (*Philosamia ricini*) avec ses excellentes propriétés de mélange avec à la fois le coton et les synthétiques est considérée comme une fibre d'avenir pour la fabrication de divers types de tissus mélangés.

INTRODUCTION

Though there are a number of sericigenous animals belonging to different Phyla and classes producing even mussel silk, spider silk etc., non-mulberry silks of significant commercial importance are produced mostly by the insects belonging to the family : *Saturniidae*, Genera : *Antheraea* and *Phylosamia* (*Cynthia*). Classified on the basis of silk produced they are :

Sl. No.	Variety of silk	Produced by	Main host plants
1	Temperate or Oak tasar	<i>Antheraea pernyi</i> G. (China)	
		<i>Antheraea yamamai</i> G. (Japan)	Various Oak or <i>Quercus</i> sp.
		<i>Antheraea roylei</i> Mr. (India)	
		<i>Antheraea proylei</i> J. (India)	
2	Tropical tasar	<i>Antheraea mylitta</i> D. (India)	<i>Terminalia tomentosa</i> <i>Terminalia arjuna</i> <i>Shorea robusta</i>
3	Muga	<i>Antheraea assama</i> W. (India)	<i>Machilus bombycina</i> <i>Litsea polyantha</i>
4	Eri	<i>Phylosamia ricini</i> H. (India and other countries)	<i>Ricinus communis</i> <i>Ailanthus</i> sp.

EXTENT OF PRODUCTION

Taking country-wise like mulberry silk China is also largest world producer of non-mulberry silk. Approximate figures of Chinese Tussah cocoon and silk production are put at 50,000 tons and 4,000 tons respectively (FAO bulletin, Rome 1980). However, as per the data presented in the XVth Congress of the International Silk Association held in London in September 1982, the silk production in China in 1981 stood at 37,400 tons including 26,400 tons of mulberry silk, 3265 tons of Tussah silk and 7684 tons of spun silk yarn. During 1982 China produced 312,000 tons of mulberry and Tussah cocoons, a 0.48 % increase over 1981, out of which about 36,000 tons of silk (a 3 % decrease) including mulberry, Tussah and spun silk were produced (as per the figures supplied by the Chinese delegation during the second session of the Regional Consultative Group on silk held at the ESCAP Secretariat in Bangkok during 12-16 December 1983). From these it may be assumed that the production of Tussah silk in China remains more or less at a steady level of about 3,000 metric tons with another about one third as the spun silk. Some amount of Eri rearing also exists in the Hebei province of China to utilize the castor plants and the heavenly tree *Ailanthus altissima* but the production is not known to be of much economic significance.

The next country with significant production of non-mulberry silks is India. She has three distinct varieties of non-mulberry silk with considerable importance

of each of them, enshrined with the traditional craft of the area. Her production of the three varieties of non-mulberry silk during 1981-1982 and 1982-1983 stood as follows :

Year	Variety of silk	Quantities produced (in metric tons)
1981-1982	Tasar	257
	Eri	147
	Muga	44
	Total	448
		===
1982-1983	Tasar	279
	Eri	173
	Muga	37
	Total	489
		===

The third country with a definite background of non-mulberry silk is Japan. She has an exquisite variety of temperate Tasar produced by *Antheraea yamamai* known as Tensan or heavenly thread. This silk is used particularly for fine embroidery on mulberry silk fabric. With differential colour affinity it stands out excellently against mulberry silk. This silk is highly valued at about US \$ 4000/- (Y 10,00,00) per kg. against US \$ 60/- (Y 15,000) per kg. of mulberry silk. Current production of cocoons and silk of *Antheraea yamamai* are about 90,000 in number and about 35 kg. respectively. But definite attempts are on to preserve and develop this silk.

In addition, Japan is perhaps the largest consumer of Oak tasar (*Antheraea pernyi*) silk, used for the the preparation of the thick belt of the Kimono and other mixed fabrics. Her import of wild silk during 1981 and 1982 remained as follows :

Year	Country imported from	Quantity in metric tons
1981	China	500.34
	North Korea	25.14
	Total	525.48
		=====
1982	China	607.92
	North Korea	18.06
	Hongkong	2.46
	Total	628.44
		=====

As will be evident from the figures given above, North Korea also produces and exports some quantity of Oak Tasar Silk. The Oak Tasar growing regions of China are situated mainly in the mountainous area of Liaoning province on the border of North Korea and thus the Tussah silk culture of North Korea may just be taken as an extension of the same. In other countries of the region, some traditional and experimental culture of Tasar and Eri are there in certain pockets but are not of any commercial significance.

PROBLEMS

Problems in the expansion of non-mulberry sericulture have been many, starting from the host plant identification their breeding, propagation and agronomy. Added to these are the problems of low fecundity, absence of assured rearing due to outdoor condition of the culture. The extraction of the silk is also not so easy as in the case of mulberry silkworm, silk layer and filament length being small in some, others being required to be treated with soda ash, pressurized steam and proteolytic enzyme before being easily reeled. Some of them like eri silk is completely unreeleable.

Less momentum in the progress of non-mulberry sericulture are due to :

- (a) less investment on research and development;
- (b) the very nature of the material.

Firstly, compared to mulberry sericulture, numbers of Institutions, Stations and persons working on non-mulberry sericulture are definitely much less. Not only that, the various non-mulberry species being endemic, located in different regions and countries, not to speak of exchange of material, even the exchange of research information has been very scanty or little. Say, tropical tasar, *Antheraea mylitta* D. or Muga *Antheraea assama* W. of India. Wherefrom to seek or exchange information with, except some general information on the group of plants or group of insects. Oak tasar culture, however, is a major field of non-mulberry sericulture where the countries of the region could co-operate with each other and work together. In this connection may be of interest the Chinese request to study the mulberry and Tussah silk of India (Ref. Chinese proposal put forward in the second session of Regional Co-operation in silk held at the ESCAP Secretariat, Bangkok 12-16 Decembre 1983). Similar facilities should be availed by India also from China for mutual benefit.

Now coming to the second question viz. basic nature of the material, non-mulberry food plants are generally slow-growing taking about 3-4 years to come to a bearing stage. Even after they come to the bearing stage, regeneration on pruning is not so quick as to provide fresh flush of good leaves to support successive rearings as in the case of mulberry. Breeding and seedling selection are possible, but vegetative propagation being difficult, it is again not easy to perpetuate the same and get a uniform population of host plant. When the basic material is not the same, it becomes difficult to work out the exact agronomic parameters.

Now turning to the silkworm, major non-mulberry silkworms viz. *Antheraea pernyi*, *Antheraea proylei*, *Antheraea yamamai*, *Antheraea mylitta* and *Antheraea yamamai* are still reared out-door only. Out-door rearings are obviously subject to extreme variations of temperature and humidity besides climatic hazards like rainfall, storm gale, hailstorms etc. They are also subject to free attack of pests and predators.

PROSPECTS

In spite of the above inherent problems and difficulties, the progress made in different fields of non-mulberry sericulture during the past one or two decades has been phenomenal. To mention some, break-through has been achieved in the selection and large scale propagation of the host plants through vating, scarification and raising of tube seedlings with 90-95% germination and survival on transplantation. With these, it has been possible to bring large areas under intensive bush cultivation boosting the production of silk. Better methods of pruning and pollarding have also been worked out. With regard to Oak Tasar various Oak varieties have been identified growing at different heights to sustain successive rearings for commercial and seed purposes. Through manipulation of photoperiodic and thermic treatments regular emergence of the Oak tasar moths for a second crop and stoppage of the unseasonal emergence have been possible. Considerable work has been done on the identification of various ecoraces, isolation, identification and fixation of more productive and viable strains including some marker strains. Studies have also been undertaken on inbreeding, selection, combining ability and hybridisation. Improvements have been brought about in the grainage technique, fecundity as well as in the control of diseases and pests of both the host plants as well as of the silkworms. Indoor rearing of the tropical tasar silkworm during the first stage and full scale indoor rearing of the Oak tasar silkworm has been possible in the Western Himalayan region. Similar attempts are on for the indoor rearing of Muga silkworm also. Artificial diets for tropical and temperate tasar silkworms are under perfection.

On the technological side, considerable improvements have come about in the field of fibre extraction in tropical tasar. For oak tasar and muga the main problem is still the low silk layer ratio and short filament length. Low content of sericin and processing with soda ash (in case of tropical tasar and muga) considerably reduce their cohesion for which various sizing materials were being used. That has been possible to be avoided very comfortably by twisting the yarn, bringing about considerable improvements in the yarn geometry also. Till now, non-mulberry silk has been reigning supreme due to its permanent natural colour, light greenish in case of Japanese Oak tasar, light creamish for Oak tasar, fawn colour for tropical tasar and golden colour for Muga. While some varieties for certain fabrics may still continue with their natural colours, to suit and meet all moods and demands, studies are needed to be urgently initiated on the dye affinity and matching in these silks.

SPECIES DIFFERENTIATION IN THE GENUS ANTHERAEA

DIFFERENCIATION DES ESPECES CHEZ LE GENRE ANTHERAEA

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The genus *Antheraea* is the largest group in the Saturniidae, comprising a variety of sericigenous insects. More than thirty-five species are distributed in the tropical, sub-tropical and temperate zones in the world. Out of these, India abodes six species. Though they are commercially important, only a few have been exploited and a large wealth of *Antheraea* fauna is yet to be put to use. It is with this view, the Indian Researchers carried out extensive studies on the taxonomy, morphology, karyology and genetics of a few species. These studies revealed the following :

1. Morphological studies such as follicular imprints in the chorion of the egg and tubercular setae provide key features for the identification of these species and to establish the affinity of the different species.
2. Genetic studies carried out on the lines of inter-specific hybridization suggested that the reproductive isolating mechanism in the genus *Antheraea* is predominantly postzygotic and species have genetically differentiated due to allopatry and varied eco-climatic conditions in the habitat.
3. Karyological studies revealed that the chromosomal fission has played a pivotal role in the karyotypic evolution in the genus. It has also been evidenced by chromosomal pairing behaviour during meiosis in the interspecific hybrid : *Antheraea roylei* ($2n=62$) x *Antheraea pernyi* ($2n=98$) in which the species, *A. pernyi* with highest chromosome number in the genus with $2n=98$ has evolved from the species *A. roylei* with model chromosome number of the genus $2n=62$.
4. *A. assama* with the lowest chromosome number $2n=30$ could be considered as an ancestral stock from which the rest of the species have diverged.

A. Sivalica which has been rightly described under A. mylitta by Hampson is only an eco-race of A. mylitta as evidenced by these studies and cannot be given the status of an independent species.

Future scope for the studies in the direction of commercial exploitation of unexplored fauna, extensive study of the eco-races and their utilization and genetic studies in the genus has been suggested by the author.

Le genre *Antheraea* est le groupe le plus important chez les Saturniidae et comprend une variété d'insectes séricigènes. Plus de 35 espèces se répartissent dans les régions tropicales, subtropicales et tempérées du globe. L'Inde accueille six de ces espèces. Bien que leur valeur économique soit importante, peu ont été exploitées et une faune importante d'*Antheraea* reste à utiliser. C'est dans cet esprit que les chercheurs indiens ont entrepris des études extensives sur la taxonomie, la morphologie, la caryologie et la génétique de quelques espèces. Ces études ont mis en lumière les points suivants :

1. Les études morphologiques telles que celles des empreintes folliculaires du chorion et des soies tuberculeuses apportent des clés pour identifier ces espèces et établir l'affinité entre les différentes espèces.

2. Les études génétiques effectuées par hybridation inter-spécifique suggèrent que le mécanisme isolateur chez le genre *Antheraea* est le plus souvent postzygotique et que les espèces se sont différenciées génétiquement grâce à l'allopatrie et aux diverses conditions éco-climatiques de l'habitat.

3. Les études caryologiques ont montré que la fission chromosomique joue le rôle central dans l'évolution du caryotype chez le genre. Ceci a été prouvé également par le comportement des chromosomes au cours de la méiose chez l'hybride inter-spécifique *Antheraea roylei* ($2n = 62$) x *Antheraea pernyi* ($2n = 98$) chez lequel l'espèce *A. pernyi* qui a le nombre chromosomique le plus élevé du genre ($2n = 98$) s'est développée à partir de l'espèce *A. roylei* ayant le nombre de chromosome type du genre ($2n = 62$).

4. *A. assama* avec le nombre de chromosomes le plus bas ($2n = 30$) peut être considéré comme le tronc commun à partir duquel les autres espèces ont divergé.

A. Sivalica qui a justement été décrit comme *A. mylitta* par Hampson est seulement une éco-race de *A. mylitta*, comme le montrent ces études et ne peut être considéré comme une espèce indépendante.

L'auteur suggère que les études soient à l'avenir tournées vers l'exploitation commerciale de la faune non-explorée, l'étude extensive des éco-races et leur utilisation, et l'étude génétique du genre.

INTRODUCTION

Natural silks of commercial importance are produced by a number of insects belonging to the genus *Bombyx* (Bombycidae), *Antheraea* (Saturniidae), *Philosamia* (Saturniidae) and *Anaphe* (Thaumetopea). Nearly ninety-five per cent of the world raw silk production is based on the mulberry silkworm, *Bombyx mori*. Among the non-mulberry silks, the genus *Antheraea* contributes bulk of the production.

Saturniidae comprises the largest group of sericigenous insects belonging to the genus *Antheraea*, *Philosamia* and *Attacus* (2). Among the sixty-one species/variants so far recorded, only a few are being exploited for commercial silk production, viz. *A. pernyi* (China), *A. yamamai* (Japan), *A. mylitta* and *A. proylei* (India). Very few systematic studies have been made so far to evaluate the economic importance of different *Antheraea* species. The present report is an attempt to bring together various information on geographic distribution, morphology, cytology and genetical studies of a few species. Their taxonomic status and phylogenetic relationships are also discussed.

Geographic distribution of *Antheraea* species/variants.

Antheraea species are distributed in three distinct regions - thirty-one in the Indo-Australian (21), three in Palearctic and one in Nearctic region (1) (Table 1). Besides, there are reports on several forms especially in the Indo-Australian region whose taxonomic status is rather confusing.

Indo-Australian region is the richest in *Antheraea* fauna. In India, there are thirteen species/variants, one in Srilanka, one in North Vietnam, eleven in Sumatra, ten in Java, nine in Borneo, eight in Philippines, five in Celebes islands, two in New Guinea, one in Australia, one in Malaysia, two in China, six in Japan and one in the U.S.A. Many of these species/variants show close affinity and their taxonomic considerations vary by different authors.

A. mylitta is the tropical tasar silkworm distributed in Eastern, Central and Southern India. *A. sivalica*, considered as a separate species and form *fraterna*, show close affinity to *A. mylitta*. In fact, Hampson has treated both these species synonymous of *A. mylitta/A. paphia*. Similarly, *A. assamensis*, *A. mesankoria* and *A. perrotei* are also considered synonymous. Thus, of the twenty-five forms reported, seven have been found to be variants of *A. mylitta* and one as that of *A. assamensis*. The relationship of remaining seventeen forms with other well defined species has not been fully investigated. In India, though there are references about several species/forms/eco-races, they belong to six well defined species namely *A. mylitta*, *A. frithii*, *A. helferi*, *A. knyvetii*, *A. assamensis* and *A. roylei*.

Geographical distribution based on altitude recognises three major groups :

- 1) low altitude (less than 150 m above MSL) - *A. assamensis* ;
- 2) Medium altitude species (150 to 600 m above MSL) - *A. mylitta*, *A. frithii*, *A. yamamai*, *A. polyphemus*;
- 3) high altitude species (700-1600 m above MSL) - *A. pernyi*, *A. roylei*.

Most of the species are polyphagous. But, based on the primary food plants, there are three groups, viz., (1) *Quercus* based *A. pernyi*, *A. roylei*, *A. yamamai* and *A. polyphemus*, (2) *Terminalia* or *Shorea* based *A. mylitta*, (3) *Machilus* based *A. assamensis*. While *Machilus/Litsea* based *A. assamensis* is limited only to North-eastern

India, the other two have wide distribution (Fig. 1) covering about 250 species under genus *Terminalia* 12 species under genus *Shorea* and 300 species under genus *Quercus*. (13).

Morphological differentiation.

Species differentiation in genus *Antheraea* and the relationship among different species have been studied based on various morphological features. Pattern of follicular imprints on the chorion of the egg, structure and arrangement of tubercles and tubercular setae on the larvae are considered as probable taxonomic clues. The affinity among *Antheraea* species based on these characters as well as the pattern of wing venation is discussed below.

Follicular imprints.

Systematic studies on the occurrence of follicular imprints over the chorion of the egg revealed that this feature is species specific in the genus *Antheraea* and is of immense taxonomic value (7, 11).

The eggs of *A. mylitta*, *A. frithii* possess two streaks or lines along the equatorial line and *A. pernyi*, *A. roylei*, *A. assamensis*, *A. polyphemus* and *A. yamamai* are devoid of such lines or streaks. Streaked eggs could be differentiated into three zones - disc, streak and edge (Fig. 2). In the streakless egg, the whole surface has been designated as disc zone. Only disc zone reveals variation in the pattern of follicular imprints in different species. The microscopic examination of the chorion reveals that follicular imprints consist of structures like main cells, intercellular bodies and intercellular space and their arrangement exhibit regular pattern in each species. The size and shape of these structures vary in different species (Fig. 3). The main cells of *A. roylei*, *A. frithii*, *A. polyphemus* are polygonal; oval in *A. pernyi* and *A. assamensis*, largest in *A. roylei*.

Tubercles and tubercular setae.

Five types of tubercles are found in the larva of *Antheraea* species (Fig. 4); Dorsal (DT), upper lateral (ULT), Lateral (LT), Lower lateral (LLT) and Caudal (CT). Number and arrangement of these tubercles remain same in *A. pernyi*, *A. roylei*, *A. assamensis*, *A. polyphemus*, *A. frithii*, *A. yamamai* and *A. mylitta*. However, *A. polyphemus* differs from the normal pattern by the presence of upper lateral and absence of lateral tubercles on the ninth abdominal segment and fused dorsal tubercle on the prothoracic hood.

The number and arrangement of tubercular setae vary according to the type of tubercle and segments on which they are borne (12). The total number of setae possessed by *A. pernyi*, *A. roylei*, *A. assamensis* and *A. polyphemus* is 462, whereas *A. mylitta*, *A. frithii* and *A. yamamai* is 502, 506 and 432. Similarly was observed in the arrangement of setae between *A. pernyi* and *A. roylei* on one hand and *A. assamensis*, *A. mylitta*, *A. frithii* and *A. yamamai* on the other. Both *A. pernyi* and *A. roylei* show knobbed setae whereas in the other species, they are pointed (Fig. 5). The distribution of tubercular setae in different segments (Table 2) clearly shows similarity among *A. assamensis*, *A. pernyi* and *A. roylei*. *A. yamamai* shows very close affinity to these species in this respect. *A. mylitta* and *A. frithii* exhibit similarity in distribution and number of setae. Among all the species, *A. polyphemus* remains a deviant.

Wing venation.

The pattern of wing venation remains same in all the species studied except for the characters viz. shape of median cross vein, its extent of connection to the base of A1 and A2 and the structure of AN3 (Fig. 6). The median cross vein is convex in *A. pernyi* and *A. roylei*, concave in *A. polyphemus* and *A. yamamai*, wavy in *A. mylitta* and *A. frithii* and straight in *A. assamensis* (Fig. 7). Bases of A1 and A2 are free in *A. assamensis*, *A. polyphemus*, *A. frithii* and *A. mylitta* A2 connects the median cross vein in *A. pernyi* and *A. roylei* (16).

Genetic differentiation.

The amount of genetic change that has occurred in the branches of phylogeny can be inferred by measuring the genetic differentiation between the species. Species that are genetically similar to each other are more likely to share a common ancestor than with the species from which they are genetically different. In the genus *Antheraea* different species were hybridized to understand the genetic distance from among different species, which in turn will enable us to establish the phylogenetic relationship. While Kawaguchi (1934) (17) carried out inter-specific crosses of *A. pernyi* and *A. yamamai*, Jolly *et al.* (1969) (5,6,10) extended the work to six more species of this genus. The details of the results of interspecific hybrids are given in table 3.

Hybrids of *A. assamensis* x *A. mylitta*, *A. pernyi* x *A. mylitta* and *A. mylitta* x *A. roylei* laid eggs, whose number was very low and failed to hatch. The reciprocals showed poor hatching, and hatched larvae were weak and did not survive upto spinning. The crosses between *A. mylitta* and *A. frithii* yielded viable offsprings which survived and spun cocoons but moths out of these were completely sterile. The cytological studies on the sterile F_1 hybrids revealed 62 unpaired chromosomes at meiotic metaphase-I (Fig. 8). This is the sum total of the chromosomes of the two parental species (12). This is due to the failure of synapsis between parental chromosomes. Thus, it appears that there is no mechanical isolation among the above species and reproductive isolating mechanism operating at postzygotic stage.

From the above results, it could be inferred that *A. mylitta* is nearer to *A. frithii* as compared to *A. assamensis* and *A. pernyi*, which are distantly related. Crosses of *A. pernyi* and *A. yamamai* also yielded similar results indicating the close relationship between these two species. The most successful interspecific cross was *A. pernyi* x *A. roylei* and its reciprocal. F_1 hybrids of these were fully fertile and vigorous. They also revealed fertility on backcrossing to either of the parental species. Morphology of the larvae, cocoons, follicular imprints were predominantly inherited from *A. pernyi* (16). The most interesting observation is that the fertility continued in selfed generation of this hybrid over 30 generations (6).

No such hybrid is known in nature as these two populations are allopatric. The high degree of heterosis in the F_1 hybrid and fertility suggest the genetic harmony between the two parental species.

Karyological differentiation.

Karyological studies in *Antheraea* are scanty. Chromosome numbers reported for different species of *Antheraea* are given in Table 4.

A. assamensis has the lowest chromosome number $2n = 30$ and *A. pernyi* the highest with $2n = 98$ in the genus *Antheraea*. The rest of the species reveal the model chromosome number of the genus $2n = 60$ to 62 (3,9,16). The chromosomal polymorphism has also been observed in *A. roylei* (14) and *A. frithii* (24), the former from Western region of India has $2n = 60, 62, 64$ and 68 , while the latter from the same region revealed $2n = 62$ and 64 . It seems in the genus *Antheraea*, the chromosomal fission has played a pivotal role in the evolution of karyotypes. This is quite plausible in *Antheraea* species, which have holocentric chromosomes. The fact that the chromosomal fission does occur in natural population of lepidoptera has been demonstrated by many workers (18, 22a, 22b, 23). In *Lysandra noviscens* ($2n = 191$), at least 166 structural rearrangements must have occurred to give rise to the highest chromosome number 191, since the typical chromosome number in Lycaenids is 23 to 24. The evidence for the chromosomal fission and its role in the karyotypic evolution has been obtained in the chromosomal behaviour during the meiosis of the interspecific hybrid *A. pernyi* ($n = 49$) $\times$ *A. roylei* ($n = 31$). This interspecific hybrid was fertile inspite of wide disparity in the chromosomal number of the parental species. Examination of meiosis revealed that the 31 chromosomes of *A. roylei* has paired with 49 chromosomes of *A. pernyi* so as to give 31 chromosome configurations in F_1 (Fig. 9). Further observations revealed the presence of trivalents in addition to bivalents. Each trivalent comprised of one *A. roylei* chromosome and two *A. pernyi* chromosomes (Fig. 10). Apparently, the chromosome of *A. roylei* which has successfully paired with two *A. pernyi* chromosomes was the parental chromosome to give rise to two *A. pernyi* chromosomes.

The chromosome numbers in the various species of *Antheraea* studied, ranges from $2n = 30$ to $2n = 98$. The various chromosomal number known for different species are 60, 62, 64 and 68. In light of the above observations, it is probable that *A. assamensis* with the lowest chromosome number is the ancestral form from which all other species have evolved.

Discussion.

Members of the genus *Antheraea* occupy different ecological niches ranging from tropical to temperate with transitional zones. The eco-climatic conditions are diverse in the habitat of different species and the distribution of food plants. Studies on taxonomy, morphology, genetic and karyotypic differentiations present very interesting features in the genus *Antheraea*. The genetic incompatibility inferred from different interspecific crosses is an evidence that the species involved differ considerably in their genomes. Reproductive isolation mechanism which appears to be postzygotic, might have occurred as a consequence of cumulative effect of the above factors on the evolution of genomes independently. However, the two process viz. reproductive isolation and speciation must go hand in hand to the extent that one is not completely the result of the other. In some species, for example, *A. mylitta*, distributed in different eco-climatic conditions, have undergone so many changes that it looks as though they are at the insipient stages of speciation. In fact, they have been more often confused to be different species of *Antheraea*.

In spite of high degree of divergence in different species of *Antheraea*, they show some affinities which are common in the genus. Based on the distribution it seems that the majority of the species have radiated from North-Eastern India. Morphological and karyotypical evidences clearly suggest that the *A. assamensis* which is endemic to north-eastern zone is the ancestral form from which the rest of the species might have evolved. *A. pernyi* and *A. roylei* which can inter-breed are close relatives and *A. yamamai* also shows affinity to this group. Similarly, *A. mylitta*, and *A. frithii* are also closely related. *A. polyphemus* which is restricted to the USA presents certain peculiarities in its morphological features, which is perhaps

due to its distinct habitat.

Conclusion.

Commercial silk production based on *Antheraea* genus is less than five per cent of the total world silk output. In terms of the number of sericigenous insects and also the wealth of food plants, immense potential exists for production of substantial quantity of non-mulberry silks. It is estimated that in India alone, the availability of *Terminalia/Shorea* based forest exceeds 11.16 million hectares and Oak based forest around 1.2 million hectares. The present exploitation is hardly 5 and 0.8 per cent respectively. However, more systematic studies on this group, detail survey on different species, races and food plants, economic feasibility, productivity linked projects etc. are necessary to develop non-mulberry sericulture. Studies reported in this paper throw light on the distribution/richness of *Antheraea* species in different regions in the world, their affinity and possibility for commercial exploitation, interspecific hybrids that are commercially viable and productive etc. may help to explore different *Antheraea* species in a systematic way and on a global basis.

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INDO-AUSTRALIAN REGION

Species	Species	Forms
1. <i>A. mylitta</i> D.	16. <i>A. mylittoides</i> Bouv.	1. <i>Sivalica</i> Mr.
2. <i>A. frithii</i> Mr.	17. <i>A. larissa</i> Ww.	2. <i>fraterna</i> Mr.
3. <i>A. compta</i> R&J.	18. <i>A. imperator</i> Wts.	3. <i>perrottetti</i> Guer.
4. <i>A. assamensis</i> Ww.	19. <i>A. pasteurii</i> Bouv.	4. <i>insularis</i> Wts.
5. <i>A. knyvetti</i> Hmps.	20. <i>A. billitonensis</i> Mr.	5. <i>cingalesa</i> Mr.
6. <i>A. andamana</i> Mr.	21. <i>A. ridleyi</i> Mr.	6. <i>fasciata</i> Mr.
7. <i>A. helferi</i> Mr.	22. <i>A. jephyra</i> niep.	7. <i>versicolor</i> Mr.
8. <i>A. roylei</i> Mr.	23. <i>A. cordifolia</i> Weym.	8. <i>pulchra</i> Mr.
9. <i>A. larisoides</i> Bouv.	24. <i>A. fickei</i> Weym.	9. <i>Ochripicta</i> Mr.
10. <i>A. pratti</i> Bouv.	25. <i>A. rumphi</i> Fldr.	10. <i>nebulosa</i> Hutt.
11. <i>A. brunnea</i> Eecke	26. <i>A. pristina</i> Wkr.	11. <i>olviscens</i> Mr.
12. <i>A. prolarissa</i> Bouv.	27. <i>A. sciron</i> Ww.	12. <i>platessa</i> Roth.
13. <i>A. surakarta</i> Mr.	28. <i>A. delegata</i> Suh.	13. <i>korintjina</i> Bouv.
14. <i>A. raffrayi</i> Bouv.	29. <i>A. eucalypti</i> sott.	14. <i>sumatrana</i> Niep.
15. <i>A. jana</i> stoll.	30. <i>A. sempresii</i> Fldr.	15. <i>javanensis</i> Bouv.
		16. <i>subcacca</i> Aunsil.
		17. <i>yongei</i> Wts.
		18. <i>borneensis</i> Mr.
		19. <i>fusca</i> Roth.
		20. <i>celebensis</i> W&S.
		21. <i>buruxensis</i> Bouv.
		22. <i>minahassac</i> Niep.

PALEARCTIC REGION

1. <i>A. pernyi</i> G.M.	1. <i>hazina</i> Butt.
2. <i>A. harti</i> Mr.	2. <i>calida</i> Butt.
3. <i>A. yamamai</i> G.M.	3. <i>morosa</i> Butt.
	4. <i>fentoni</i> Butt.
	5. <i>sergestus</i> Ww.

NEARTIC REGION

1. <i>A. polyphemus</i> crum.

Table 1. Distribution of *Antheraea* species/variants.

Tubercle	Segment	<i>A. yamamai</i>	<i>A. pernyi</i>	<i>A. roylei</i>	<i>A. assamensis</i>	<i>A. mylitta</i>	<i>A. frithii</i>	<i>A. polyphemus</i>
DORSAL	Pro-thoracic hood	16	16	16	16	16	16	24
	Thorax 2-3rd	28	28	28	28	32	32	32
	Abd. 1-7th	70	84	84	84	84	84	84
	Abd. 8th	8	8	8	8	8	16	8
	Abd. 9th	14	14	14	14	18	18	14
UPPER LATERAL	Thorax 2-3rd	24	24	24	24	24	24	28
	Abd. 1-2nd	16	20	20	20	20	20	28
	Abd. 3-8th	48	60	60	60	60	60	48
	Abd. 9th	-	-	-	-	-	-	16
LATERAL	Thorax 1st	28	26	26	26	30	26	30
	Thorax 2-3rd	28	28	28	28	32	32	24
	Abd. 1-8th	112	112	112	112	128	128	96
	Abd. 9th	14	14	14	14	18	16	-
LOWER LATERAL	Thorax 1st	6	8	8	8	12	10	8
	Thorax 2-3rd	12	12	12	12	12	12	8
TOTAL		432	462	462	462	506	506	462

Table 2. Results of different interspecific crosses in *Antheraea*.

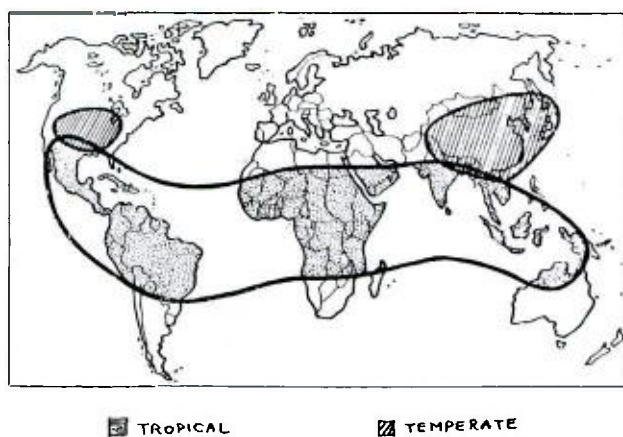
Cross	Hatching %	% viability	Fertility/sterility in F ₁
A. assamensis x A. mylitta	-	-	-
A. mylitta x A. assamensis	0.5	-	-
A. mylitta x A. pernyi	11.5	-	-
A. pernyi x A. mylitta	-	-	-
A. roylei x A. mylitta	5.0	-	-
A. mylitta x A. roylei	-	-	-
A. mylitta x A. frithii	34.8	21.4	Sterile
A. frithii x A. mylitta	41.8	41.2	Sterile
A. roylei x A. pernyi	20.2	57.3	Fertile
A. pernyi x A. roylei	100.0	36.5	Fertile
A. yamamai x A. pernyi	Results not known		Sterile
A. pernyi x A. yamamai			Sterile

Table 3. Results of interspecific crosses in *Antheraea*.

Species	Chromosome number (n)	Author(s)
A. assamensis	15	Deodikar et al. 1962
A. roylei	30 31,32,34	Jolly et al. 1970 Jolly et al. 1974
A. polyphemus	30	Cook, 1910
A. mylitta	31	Jolly et al. 1973
A. frithii	31 32	Jolly et al. 1973 unpublished
A. yamamai	31	Kawaguchi, 1934
A. pernyi	49	Kawaguchi 1933

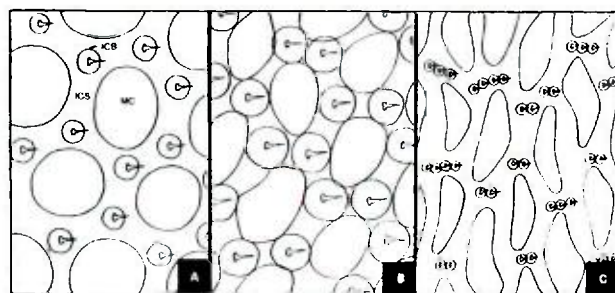
Table 4. Chromosome numbers in different species of *Antheraea* (Source : Non-Mulberry Silks; FAO, Rome, 1979).

FIGURE 1



Global distribution of tropical and temperate tasar flora.

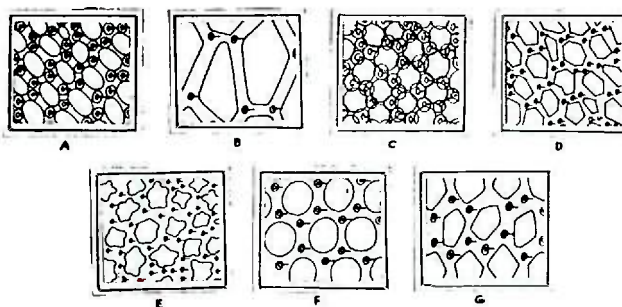
FIGURE 2



PATTERN OF FOLLICULAR IMPRINTS ON THE EGG OF ANTHERAEA

(A) DISC (B) STREAK (C) EDGE ZONES

FIGURE 3

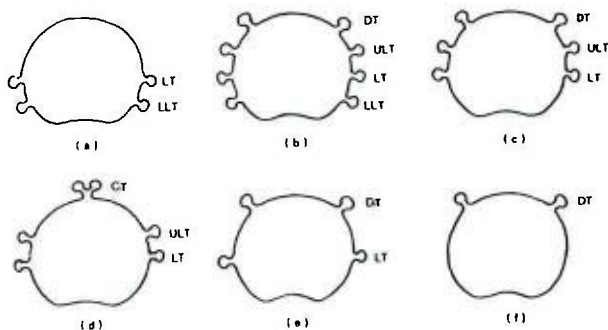


• PATTERN OF FOLLICULAR IMPRINTS IN ANTERAEA SPECIES

A. A. PERNYI B. A. ROYLEI C. A. ASSAMENSIS D. A. POLYPHEMUS

E. A. YAMAMAI F. A. MYLITTA G. A. FRITHII

FIGURE 4



ARRANGEMENT OF TUBERCLES IN ANTERAEA

(a) 1st THORACIC (b) 2nd & 3rd THORACIC

(c) 1st - 7th ABDOMINAL (d) 8th ABDOMINAL (e) 9th ABDOMINAL

(f) 10th ABDOMINAL SEGMENTS

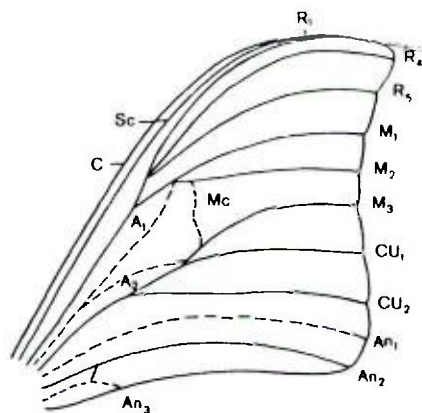
FIGURE 5

	A	B	C	D	E	F	G
NUMBER	462	462	462	462	432	502	506
9TH ABD LT				ABSENT			
9TH ABD ULT	ABSENT	ABSENT	ABSENT		ABSENT	ABSENT	ABSENT
STRUCTURE							
ARRANGEMENT							

STRUCTURE, ARRANGEMENT AND NUMBER OF
TUBERCULAR SETAE IN ANTHERAEA SPECIES.

A. A. ROYLEI B. A. PERNYI C. A. ASSAMENSIS
D. A. POLYPHEMUS E. A. YAMAMAI F. A. MYLITTA
G. A. FRITHII

FIGURE 6



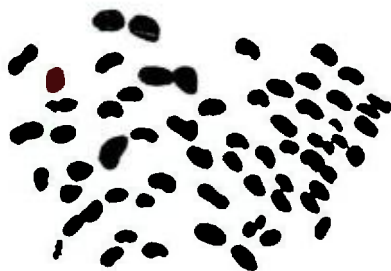
• PATTERN OF WING VENATION IN
ANTHERAEA SPECIES

FIGURE 7

CHARACTERS	SPECIES						
	A. ROYLEI	A. PEROTTI	A. ASSAHEHNS	A. POLYPHEMUS	A. TAMAMUS	A. MYLITTA	A. FRITHI
STRUCTURE OF MC	)	)		(	(	)	)
ALIGNMENT OF A, B & A ₂ WITH MC							
DEVELOPMENT OF A ₂	STRONG	WEAK	STRONG	STRONG	WEAK	WEAK	STRONG

- DISTINGUISHING FEATURES IN THE WING VENATION OF ANTHRAEA SPECIES

FIGURE 8



Meiotic metaphase-I in the interspecific hybrid, *A. mylitta* x *A. frithii* (n=31) showing 62 unpaired chromosomes.

FIGURE 9



Diakinesis in the interspecific hybrid,
A. roylei ($n=31$) $\times$ *A. pernyi* ($n=49$) showing 31 chromosomal configurations
(16 trivalents + 13 bivalents).

FIGURE 10



Trivalents showing pairing of one *A. roylei* chromosome (R)
with two *A. pernyi* (P) chromosomes.

A COMPARATIVE STUDY OF BUNCH AND TRAY FEEDING IN ERICULTURE
USING CASTOR (RICINUS COMMUNIS) AND KESSERU (HETEROPANAX FRAGRANS)
AS FOOD PLANTS

ETUDE COMPARATIVE DE L'ELEVAGE SUR CLAIES ET DE L'ELEVAGE
SUR BUISSON EN ERICULTURE, UTILISANT COMME PLANTES NOURRICIERES
LE RICIN (RICINUS COMMUNIS) ET LE KESSERU (HETEROPANAX FRAGRANS)

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India.*

Though earlier workers stressed the importance of bunch feeding in ericulture with respect to silkworm hygiene and the economy of labour, very little is known about its benefits. During the course of the present study silkworms fed with castor (Ricinus communis) in bunch has so far showed better larval weight, effective rate of rearing, shell ratio, moth emergence, fecundity, etc., than those fed in tray. But when Kesseru (Heteropanax fragrans) is fed to the worms in the same manner, there appeared to be no significant variation in the above factors. This may be attributed to the micro-climate created by the different types of leaves as well as other environmental factors prevailing.

Bien que des chercheurs aient déjà souligné l'importance de l'élevage sur buisson en ériculture en matière d'hygiène et d'économie de main-d'oeuvre, ses avantages sont très mal connus. Au cours de cette étude, les vers à soie élevés sur ricin en buisson (Ricinus communis) ont montré de meilleures performances quant au poids larvaire, au taux effectif d'élevage, à la richesse soyeuse, à l'émergence des papillons, à la fécondité, etc., que les vers élevés sur claies. Mais lorsque le même type d'élevage est effectué sur Kesseru (Heteropanax fragrans), on n'observe aucune variation significative de ces facteurs. Ceci peut être dû au micro-climat créé par les différents types de feuilles ou par d'autres facteurs prédominants de l'environnement.

BACILLARY NODULES ON THE GUT WALL OF ANTHERAEA MYLITTA LARVAE

NODULES MICROBIENS SUR LA PAROI INTESTINALE DES LARVES DE
ANTHERAEA MYLITTA

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Dark spots other than those typically found in larvae infected by *Nosema* sp. (microsporidiosis) were observed on some larvae of *Antheraea mylitta* D. Histopathological studies revealed dark nodular outgrowths on the outer surface of mid gut facing haemolymph. Haemolymph contained heavy bacillary infection. Microtomial sections when passed through silver nitrate test and Giemsa staining solution showed vacuolization and fenestration of mid gut cells. Haemocytes adherent to the bacillae on the outer surface of mid gut finally disintegrate forming a cytoplasmic matrix which subsequently becomes melanized.

Nous avons observé sur des larves de *Antheraea mylitta* D des taches noires autres que celles que l'on trouve chez les larves infectées par *Nosema* sp. (microsporidiosis). Des études histopathologiques ont révélé des excroissances nodulaires noires sur la paroi externe de l'intestin moyen faisant face à l'hémolymph qui est fortement infectée par des bacilles. Les coupes effectuées au microtome traitées au nitrate d'argent et colorées par une solution de Giemsa montrent des vacuoles et des ouvertures dans les cellules de l'intestin moyen. Les hémocytes adhérent aux bacilles sur la paroi externe de l'intestin moyen sont finalement désintégrés formant une matière cytoplasmique qui par la suite est mélanisée.

ECONOMIC POTENTIAL OF ERICULTURE (CASTOR SILK)
AS AN AGRO-COTTAGE INDUSTRY IN SEMI ARID REGIONS
OF RAJASTHAN, INDIA

POTENTIEL ECONOMIQUE DE L'ERICULTURE
EN TANT QU'INDUSTRIE AGRICOLE FAMILIALE
DANS LES REGIONS SEMI-ARIDES DU RAJASTHAN, INDE

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Castor is grown around Jodhpur to protect the cash crops like chillies, fennel, cotton, etc., from cold winds. The cost of castor cultivation is paid by the cash crop. Castor leaves are not used by man and his animals and thus go waste. These leaves can be used for rearing eri silkworms and thus additional profit can be obtained. Preliminary studies showed that eri silkworms can easily be reared under village conditions for at least three generations in a year (Misra, 1978).

An attempt has been made to work out the economics of ericulture when four castor cultivars namely Aruna, Assam local, Bilara local and Udaipur local plants were grown in a row distance of 40, 80 and 120 cm with no defoliation and partial defoliation (40%). A clear remunerative role of castor from view point of ericulture rather than growing for seed alone is evident. The highest income is obtained in 40 cm row spacing in Aruna cultivar.

Dans la région de Jodhpur, le ricin est cultivé pour protéger les cultures à revenu monétaire comme les piments, l'aneth, le coton, etc, contre les vents froids. Le coût de la culture du ricin est supporté par le revenu des autres cultures. Les feuilles de ricin ne sont pas utilisées par l'homme, ni par ses animaux et donc gaspillées. Ces feuilles peuvent être employées

pour élever des vers à soie eri et apporter un bénéfice supplémentaire. Des études préliminaires ont montré que trois élevages de vers à soie eri peuvent être effectués chaque année en milieu rural (Misra, 1978).

Une étude économique de l'ériculture est effectuée avec quatre cultivars de ricin (Aruna, Assam local, Bilara local et Udaipur local) dont les plants sont cultivés par rangées distantes de 40, 80 et 120 cm, sans défoliation et avec défoliation partielle (40 %). L'utilisation du ricin pour l'ériculture est très rémunératrice par rapport à la culture pour la semence. Le revenu le plus élevé est obtenu pour la culture en rangées espacées de 40 cm chez le cultivar Aruna.

SERI-ECOSYSTEM REQUIRES PROTECTION WITH SPECIAL REFERENCE
TO INDIAN NON-MULBERRY SILK INDUSTRY

LA PROTECTION DE L'ECOSYSTEME SERICICOLE EST NECESSAIRE
POUR LA SERICICULTURE NON-MURIER EN INDE

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India having rich sericegenous fauna dispersed in continental forest flora have formed ecological niches. This provides basic infrastructure for commercial exploitation of tasar, eri and muga sector. Un-noticed damage on seri-ecosystem due to deforestation, pollution and changes in agroclimatic conditions have warranted the necessity to review the situation in situ. The communication stress the need of survey, collection and preservation of sericegenous insect. Potentialities of other sericigenous insect i.e. *Attacus atlas* and *Actias selene* H. for its commercial exploitation are to be assessed. Tool of natural breeding should be encouraged for increasing non-mulberry silk productivity. Legislative protection for preservation of specific food plants and sericigenous fauna requires considerable attention.

L'Inde possède une faune séricigène importante dispersée dans la forêt continentale qui a formé des niches écologiques. Ceci fournit une infrastructure pour l'exploitation commerciale du ver à soie tassar, eri et muga. Une dégradation de l'écosystème séricicole due au déboisement, à la pollution et aux variations des conditions agroclimatiques justifie la nécessité de revoir la situation in situ. Cet article met l'accent sur le besoin du dénombrement, de la collecte et de la protection des insectes séricigènes. Les possibilités d'exploitation commerciale d'autres séricigènes comme *Attacus atlas* et *Actias selene* H. doivent être étudiées. La sélection naturelle devrait être soutenue pour accroître la productivité de la soie non-mûrier. La législation pour la protection des plantes nourricières spécifiques et de la faune séricigène demande une attention considérable.

UZI FLY INFESTATION IN ANTHERAEA PROYLEI J.
AND ITS CONTROL MEASURES

INFESTATION DE ANTHERAEA PROYLEI J. PAR LA MOUCHE OUZY
ET MOYENS DE PREVENTION

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Tachinid fly infestation in A. proylei J. caused by Parasarphaga knabi (Parkar) in epidemic form has posed serious problem in whole oak tasar belt, in India. Present communication reports that 3rd to 5th stage silkworm and 2nd to 4th body segment are more susceptible for infestation. Mechanical control by scraping fly pest eggs with the help of water soaked camel hair brush has reduced the infestation to 9.4% against 62.9%. Dfl: seed/cocoon ratio was found to be 1:3.7 against 1:0.80 and thus has got scope for implementation in commercial scale along with the use of citronella oil and phenyl as repellent.

L'infestation causée par Parasarphaga knabi (Parkar) sous forme épidémique de A. proylei J. et due à la mouche Tachinide, pose de sérieux problèmes dans toute la région du tasar du chêne en Inde. Le présent article rapporte que le ver à soie du 3ème au 5ème âge, la partie du corps entre le 2ème et le 4ème segment, sont plus sensibles à l'infestation. La prophylaxie mécanique, c'est-à-dire par raclage des oeufs de la mouche parasite à l'aide d'une brosse en poil de chameau humide, a réduit l'infestation de 62,9 % à 9,4 %. Le rapport graines/cocons est de 1/3,7 contre 1/0,8 ce qui permet donc la mise en oeuvre à l'échelle commerciale, en y associant l'utilisation de l'essence de citronnelle et du phényl comme répulsifs.

STUDIES ON EFFECT OF SEED TREATMENT AND GRADATION
ON GERMINATION BEHAVIOUR OF TERMINALIA TOMENTOSA W.A.
(MYRTALES : COMBRETACEAE)

ETUDE DE L'EFFET DU TRAITEMENT ET DU CALIBRAGE DES GRAINES
SUR LA GERMINATION DE TERMINALIA TOMENTOSA W.A.

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T. tomentosa W.A. is a food plant of prime importance in traditional tasar culture in India. Crystallization of block plantation concept for ensuring better productivity has warranted the necessity to undertake studies on seedling propagation. The effect of water soaking treatment for stipulated period has revealed significant picture for treatment, duration and their interactions for almost all the characters observed. Heavier seeds (4.0 gr. and above) have shown better germination potential.

T. tomentosa W.A. est une plante nourricière de première importance pour l'élevage traditionnel du tassar en Inde. La cristallisation du concept de plantation groupée afin d'amener une meilleure productivité justifie la nécessité d'entreprendre des études sur la multiplication des plants. Les effets du détrempage pendant des périodes données révèlent une image significative pour le traitement, la durée et leurs interactions avec presque tous les caractères observés. Les graines les plus lourdes (4 g et plus) possèdent le meilleur potentiel germinatif.

REVUE DES LIVRES

BOOK REVIEW

CONTRÔLE DE LA REPRODUCTION, DU DÉVELOPPEMENT ET DU SEXE CHEZ LE VER À SOIE

par Vladimir A. STRUNNIKOV

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Publié par : MIR Publishers, 2 Pervy Rizhsky Pereulok, 1-110, GSP, Moscow, 129820, U.S.S.R., 1983.- *Advances in Science and Technology in the U.S.S.R.*, Biology series. 280 p.

Traduit du russe en anglais by P.E. CHERNILOVSKAYA and V.V. KUZNETSOV.
Traduction supervisée par I.A. ZHKHAROV.

On ne peut mieux faire que reproduire la présentation de ce livre par l'éditeur :

"Cet ouvrage de V.A. Strunnikov, Membre de l'Académie des Sciences d'U.R.S.S., est le résultat de près d'un demi siècle d'études originales sur le ver à soie. Il décrit des méthodes de reproduction artificielle du ver à soie : parthénogenèse méiotique et améiotique, androgenèse mono et bi-paternelle et gynogenèse. Il propose 5 techniques de laboratoire et 3 techniques commerciales pour le contrôle du sexe chez le ver à soie, une compilation d'un grand intérêt scientifique et pratique. De plus, ce livre fait le point sur le développement de techniques permettant l'analyse du génome, l'analyse rapide de la fréquence spécifique de divers types de mutations induites, l'élimination de gènes récessifs indésirables des populations de vers à soie et conduisant ainsi à des copies génétiquement identiques de spécimens ayant une valeur économique exceptionnelle, la création contrôlée de formes donnant une hétérosis vigoureuse chez les hybrides F_1 (élaborée pour la première fois). Cet ouvrage propose également de nouvelles méthodes de sélection. Il intéressera les biologistes, les généticiens, les éleveurs de vers à soie, les embryologistes, les entomologistes, les enseignants et les étudiants des universités."

Trois grands chapitres :

1. Méthodes artificielles de reproduction du ver à soie.
2. Mise au point de techniques de contrôle du sexe chez le ver à soie dans les élevages commerciaux.
3. Quelques aspects de la reproduction contrôlée pour la sélection.



CONTROL OF SILKWORM REPRODUCTION DEVELOPMENT AND SEX

By Vladimir A. STRUNNIKOV

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Published by : MIR Publishers, 2 Pervy Rizhsky Pereulok, 1-110, GSP, Moscow, 129820, U.S.S.R., 1983.- Advances in Science and Technology in the U.S.S.R., Biology series. 280 p.

Translated from Russian into English by P.E. CHERNILOVSKAYA and V.V. KUZNETSOV. Translation edited by I.A. ZAKHAROV.

The best we can do is to reprint herebelow the foreword from the publishers :

"This book by V.A. Strunnikov, Corresponding Member of the U.S.S.R. Academy of Sciences, is the result of almost half a century of original studies of the silkworm. It describes methods for the artificial reproduction of the silkworm : meiotic and ameiotic parthenogenesis, androgenesis, uni- and bipaternal androgenesis and gynogenesis. It proposes 5 laboratory and 3 commercial techniques for sex control in the silkworm, an achievement of great scientific and practical importance. Besides this, the book deals with the development of techniques for genome analysis, express analysis of the specific frequency of various types of induced mutations, clearing silkworm populations of deleterious recessive genes, obtaining genetically identical copies of specimens of exceptional commercial value, controlled creation of forms with a vigorous heterosis in F_1 hybrids (elaborated for the first time). It also proposes new methods for selection. The book will interest biologists, geneticists, silkworm breeders, embryologists, entomologists, university teachers and students."

Three major parts :

1. Artificial methods of reproducing the silkworm.
2. Development of commercial techniques for sex control in the silkworm.
3. Some aspects of controlled reproduction in breeding.

☆☆

REVUE SIGNALÉTIQUE

BIBLIOGRAPHY

LIST OF LANGUAGE SYMBOLS USED

(Bg) Bulgare
Bulgarian

(C) Chinois
Chinese

(D) Allemand
German

(E) Anglais
English

(F) Français
French

(J) Japonais
Japanese

(K) Coréen
Korean

(Pl) Polonais
Polish

(pt) Portugais
Portuguese

(R) Russe
Russian

(Ro) Roumain
Rumanian

(S) Espagnol
Spanish

The corresponding small letters are used for indicating the language of the summary.

R : We have a copy of this article.

LISTE DES INDICATIFS DE LANGUES UTILISÉES

Les lettres minuscules correspondantes sont utilisées pour indiquer la langue du résumé.

R : Nous possédons un exemplaire de cet article.

SERICICULTURE GENERALE / GENERAL SERICULTURE

An.

Achievements in sericultural sciences and technology in our country during recent 35 years since the People's Republic of China was founded. (Résultats obtenus dans notre pays en sciences et technologie séricicoles pendant les 35 dernières années, depuis la création de la République Populaire de Chine.)

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On methods of rearing tussah silkworms in Qing dynasty, as judged from the contents of ancient writings such as "Records of Wild Silkworms". (Méthodes d'élevage du ver à soie tussah sous la dynastie Qing d'après les manuscrits anciens tels que le "Rapport sur les Vers à Soie Sauvages".)

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Studies on the fauna and ecology of birds destructive to Chinese tussah silkworm in Yanbian area. (Etude de la faune et écologie des oiseaux prédateurs du ver à soie tussah chinois dans la région de Yanbian.)

Ganye Kexue, 1984, 10(1), p. 58. (C) R

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On the analysis of cocoon cooking peculiarity in filature. (Analyse de la particularité de la cuisson des cocons en filature.)

Reports of the Silk Sci. Res. Inst., 1984, 32, p. 61-72. (J,j) R

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Studies on control of the katydids in the Chinese tussah silkworm rearing areas with "Sha Dong Dan 1". (Etudes sur le contrôle des sauterelles vertes dans les régions d'élevage du ver à soie tussah chinois, à l'aide du "Sha Dong Dan 1".)

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Reports of the Silk Sci. Res. Inst., 1984, 32, p. 1-6. (J,j) R

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Evaluation of the Okinawa shimaguwa mulberries and the Taiwan encouraging mulberries as a cultivated mulberry. (Evaluation des mûriers Okinawa shimaguwa et des mûriers de Taïwan, en plantation.)

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Brief information on the simple mulberry leaves cutter. (Courte note sur le couteau utilisé pour couper les feuilles de mûrier.)

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MURIER / MULBERRY

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Planta Medica, 1984, 50, p. 218.

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Structure of mulberrofurans F and G, two natural hypotensive Diels Alder type adducts from the cultivated mulberry tree (*Morus Ihou* Koidz). (Structure des mulberrofurans F et G, deux adduits du type Diels Alder naturels hypotensifs provenant du mûrier cultivé (*Morus Ihou* Koidz))

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Structure of mulberrofuran 1, a novel 2-arylbenzofuran derivative from the cultivated mulberry tree (*Morus bombycis*). (Structure du mulberrofuran 1, un nouveau dérivé 2-arylbenzofuran provenant du mûrier cultivé (*Morus bombycis*).)

Chem. Pharm. Bull., 1984, 32, p. 1260.

HOMMA S., LOU C.F., KUNO K.

On the relationship between photosynthetic rates and morphogenesis of mulberry leaves in the early growth stage in spring. (Relation entre les taux de photosynthèse et la morphogénèse des feuilles de mûrier au début de la croissance au printemps.)

J. Seric. Sci. Jpn., 1984, 53(2), p. 127-134. (J,j,e) R

Studies were carried out on the relationships between the photosynthetic rates and morphogenesis of leaves such as leaf thickness and stomatal distributions in the early growth stage of mulberry in spring. Apparent photosynthetic rates soon after unfolding showed negative value, but became positive in about one week thereafter, and reached the maximum in about 20 days after unfolding. Photosynthetic rates among varieties were in the order of Kenmochi > Kairyonezumigaeshi > Kairyoichinose = Kokuso No 21. Dark respiratory rate was maximal soon after unfolding and lowered thereafter. There existed high correlations between photosynthetic rates or dark respiratory rates and number of days after unfolding. Values of stomatal distribution and leaf thickness were small soon after unfolding but increased thereafter, and reached maximum in 20 days after unfolding. Between stomatal distribution or leaf thickness and number of days after unfolding, and furthermore, between stomatal distribution or leaf thickness and photosynthetic rates, high correlations were found. Thus, close relationships were recognized between increase of photosynthetic rates and leaf morphogenesis.

Des études sont effectuées sur les relations entre les taux de photosynthèse et la morphogénèse des feuilles, comme l'épaisseur de la feuille et la fréquence des stomates, au début de la croissance du mûrier au printemps. Les taux de photosynthèse apparents sont négatifs juste après le débourrement, mais deviennent positifs environ une semaine après et atteignent leur maximum environ 20 jours après le débourrement. Les taux de photosynthèse selon les variétés sont : Kenmochi > Kairyonezumigaeshi > Kairyoichinose = Kokuso 21. Le taux de respiration dans l'obscurité est à son maximum pendant le débourrement de la feuille et diminue ensuite. Il existe des corrélations importantes entre les taux de photosynthèse ou les taux de respiration et le nombre de jours après le débourrement des feuilles. Les valeurs de distribution des stomates et d'épaisseur de la feuille sont faibles juste après le débourrement mais augmentent ensuite, et sont à leur maximum 20 jours après. Des corrélations importantes sont trouvées entre la distribution des stomates ou l'épaisseur de la feuille et le nombre de jours après le débourrement et bien plus, entre la distribution des stomates ou l'épaisseur de la feuille et les taux de photosynthèse. Donc, des relations étroites existent entre l'augmentation des taux de photosynthèse et la morphogénèse de la feuille.

HOMMA S., LOU C.F., KUNO K.

On the relationship between photosynthetic rates and morphogenesis of mulberry leaves after summer pruning. (Relation entre les taux photosynthétiques et la morphogénèse des feuilles de mûrier après la taille de l'été.)

J. Sericult. Sci. Japan, 1984, 53(2), p. 135-140. (J,j,e) R

In order to clarify the relationship between photosynthetic rates and morphogenetic changes of mulberry, the experiment was carried out using mulberries grown in the field. Apparent photosynthetic rates after summer pruning changed from minus to plus values in 5 days after unfolding, in any one of four varieties, and reached the maximum in about 40 days. Among these varieties, values in largeness were in the order of Kenmochi > Kairyoichinose > Kairyonezumigaeshi > Kokuso No. 21. Dark respiratory rates were high soon after unfolding, reduced rapidly with the progress of leaf age, and reached constant value in about three weeks. The value in Kenmochi was high, but

those in other three varieties were low and almost similar among them. Stomatal distribution was low soon after unfolding and reached the maximum (about 950 stomata/mm²) in about 20 days. The distribution in mature leaves surpassed that in early spring by 150 stomata/mm². Leaf thickness in four varieties soon after unfolding was about two-fifths of that in mature leaves and became thick with progress of leaf age. It took 18 days after unfolding in Kenmochi, 25 days in Kairyoichinose and 33 days in Kokuso No. 21. The differences in leaf thickness of mature leaves were within 10 µm.

Afin de clarifier la relation entre les taux photosynthétiques et les changements morphogénétiques du mûrier, nous avons effectué des expériences sur des mûriers des champs. Les taux photosynthétiques apparents après la taille de l'été passent d'une valeur négative à une valeur positive 5 jours après le débourrement, dans chacune des 4 variétés, et atteignent la valeur maximale au bout de 40 jours environ. Ces quatre variétés peuvent se classer en fonction de leurs valeurs décroissantes de la façon suivante : Kenmochi > Kairyoichinose > Kairyonezumigaeshi > Kokuso 21. Les taux de respiration nocturne sont élevés peu de temps après le débourrement, ils diminuent rapidement avec le vieillissement de la feuille et atteignent une valeur constante au bout de trois semaines environ. La valeur chez Kenmochi est élevée mais les valeurs des autres variétés sont faibles et pratiquement identiques entre elles. La fréquence des stomates est faible peu de temps après le débourrement et atteint la valeur maximale (environ 950 stomates/mm²) en 20 jours. La fréquence chez les feuilles matures dépasse celle des feuilles du début du printemps de 150 stomates/mm². L'épaisseur de la feuille chez les quatre variétés peu de temps après le débourrement représente environ 2/5 de l'épaisseur des feuilles matures ; elle augmente en même temps que la feuille vieillit. La maturité est atteinte 18 jours après le débourrement chez Kenmochi, 25 jours chez Kairyoichinose et 33 jours chez Kokuso 21. Les différences dans l'épaisseur des feuilles matures ne dépassent pas 10 µm.

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KUNO K.

Cyto-histological features of malformations in mulberry roots induced by heavy metals. (Caractères cyto-histologiques des malformations dans les racines de mûrier induites par les métaux lourds).

J. Sericult. Sci. Japan, 1984, 53(3), p. 191-197. (E,e) R

Anatomical studies on the effects of heavy metals on the morphogenesis of mulberry roots were carried out, using malformed roots induced by heavy metals. Cadmium-induced imbalances in the growth of root tissue were observed, especially inhibition of cell division in the cortex, shrinkage of stelar cells by extraordinary expansion of cortical cells, cell crushing and malformations of the nuclei. Copper mainly induced histogenetic disorders of the root apex, chimerization of the tissues, imbalance of cell growth within and between tissues, separation of the tissues from each other and condensation of nuclear matter by collapse of the membrane system. Zinc affected scarcely root morphogenesis and induced only local swelling of the cortex.

Nous avons effectué des études anatomiques sur les conséquences des métaux lourds sur la morphogénèse des racines de mûrier en utilisant des racines avec des malformations provoquées par des métaux lourds. Nous avons observé des déséquilibres provoqués par le cadmium dans la croissance des tissus des racines, particulièrement l'inhibition de la division des cellules dans le cortex, le rétrécissement des cellules de la stèle dû à l'expansion des cellules du cortex, l'écrasement des cellules et des malformations des noyaux. Le cuivre provoque principalement des désordres his-

togénétiques dans l'apex des racines, une "chimérisation" des tissus, un déséquilibre de la croissance dans et entre les tissus, une séparation des tissus les uns des autres et une condensation des matières nucléaires par effondrement du système membranaire. Le zinc affecte peu la morphogénèse de la racine et provoque uniquement des tumeurs locales du cortex.

KUNO K.

Effects of heavy metals on photosynthetic rates and morphogenesis in mulberry leaves. (Effets des métaux lourds sur les taux photosynthétiques et la morphogénèse des feuilles de mûrier).

J. Sericult. Sci. Japan, 1984, 53(3), p. 198-204. (E,e) R

In order to obtain useful information about the mechanism of damage caused by excess heavy metals to mulberry growth, studies were carried out on the effects of cadmium, copper and nickel on photosynthetic rates and morphogenesis in mulberry leaves. Each heavy metal inhibited markedly increase of dry weight of newly formed leaves after the beginning of treatment at high concentrations. Copper showed strong reductive effects on specific leaf weight. Cadmium, copper and nickel reduced photosynthetic rates at high concentrations. Chlorosis occurred in middle leaves due to cadmium and in middle or lower leaves due to nickel. A reduction of chlorophyll content was induced in mulberry leaves at high concentrations of cadmium and nickel. Stomatal formation and development of leaf veins were suppressed at high concentrations of copper and cadmium. But thickened growth of mesophyll was slightly suppressed by nickel.

Pour obtenir des informations sur le mécanisme des dégâts dans la croissance des mûriers par un excès de métaux lourds, nous avons étudié les effets du cadmium, du cuivre et du nickel sur les taux photosynthétiques et la morphogénèse des feuilles de mûrier. Chaque métal lourd inhibe nettement l'augmentation de poids sec des jeunes feuilles après le début du traitement à forte concentration. Le cuivre a des effets réducteurs sur le poids spécifique de la feuille. Le cadmium, le cuivre et le nickel réduisent les taux photosynthétiques lorsque leur concentration est élevée. La chlorose survient dans les feuilles médianes à cause du cadmium et dans les feuilles basses à cause du nickel. De fortes concentrations de cadmium et de nickel provoquent une réduction de la teneur en chlorophylle dans les feuilles de mûrier. La formation des stomates et le développement des nervures s'arrêtent avec des concentrations élevées de cadmium et de cuivre. Mais l'épaississement du mésophylle est légèrement perturbé par le nickel.

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LI S., et al.

On estimating the mulberry leaf yield by measuring the average length of branches and counting the number of leaves on the branch. (Estimation du rendement en feuilles du mûrier en mesurant la longueur moyenne des branches et en comptant le nombre de feuilles par branche.)

Canye Kexue, 1984, 10(1), p. 56. (C) R

LOU CHENG FU

The relation between the respiratory rate and the diameter of the shoots of different varieties of mulberry trees in winter. (Relation entre le taux de respiration et le diamètre des rameaux de différentes variétés de mûrier en hiver.)

Canye Kexue, 1984, 10(1), p. 1. (C) R

LOU CHENG FU

The relationships among water content in mulberry leaves, photosynthetic rate, transpiration rate and stomatal resistance. (Relations existant entre la teneur en eau des feuilles de mûrier, le taux de photosynthèse, le taux de transpiration et la résistance des stomates.)

Canye Kexue, 1984, 10(3), p. 129-133. (C) R

MATSUNO M., NISHINA S.

Appearance period and distribution of initial lesions on mulberry branches infected with die back caused by *Diaporthe nomurai* Hara. (Période d'apparition et distribution des lésions initiales sur les branches de mûrier affectées de dogâre causé par *Diaporthe nomurai* Hara.)

J. Seric. Sci. Jpn., 1984, 53(2), p. 175. (J) short report. R

MATSUNO M., NISHINA S.

Control of die back in mulberry tree by spraying thiophanate-methyl in summer and formaldehyde or PCP-copper in autumn. (Contrôle du dogâre chez le mûrier par vaporisation de thiophanate-méthyl en été et de formaldéhyde ou PCP-cuivre en automne.)

J. Seric. Sci. Jpn., 1984, 53(2), p. 177. (J) short report. R

MURAKAMI T.

Reserve substance and photosynthesis related to the early growth in cutting propagation of mulberry plant. (Substance de réserve et photosynthèse liée au début de la croissance lors de la multiplication du mûrier par le bouturage.)

Sanshi Shikenjo Hokoku, 1983, 29(1), p. 1-164. (J)

NI G., et al.

On propagating Hu-Sang, a group of mulberry varieties, by means of cuttings. 3) An experiment on inducing the mulberry cuttings by quick immersion in the solution of 1.B.A. (Multiplication des variétés de mûrier du groupe Hu-Sang, par bouturage. 3) Une expérience pour induire la prise des boutures en les immergeant dans une solution d'1.B.A. pendant très peu de temps.)

Canye Kexue, 1984, 10(2), p. 63. (C) R

NONG C., et al.

A study on the incidence and control of mulberry root knot disease. (Etude sur l'incidence et le contrôle de la maladie provoquée par le nématode de la racine du mûrier.)

Canye Kexue, 1984, 10(2), p. 77. (C) R

OGURE M.

Genetic studies on the intergeneric grafting between mulberry and mulberry related-genera. (Etudes génétiques sur le greffage intergénérique entre mûrier et genres voisins.)

Bull. Seric. Exp. Station, 1984, 29(2), p. 165-257. R

OHNISHI T.

Effect of gibberellin treatment on vitality of mulberry roots. (Effets du traitement à la gibberelline sur la vitalité des racines de mûrier.)

Nippon Sakumotsu Gakkai Kiji, 1983, 52(3), p. 373-374. (J)

QI C.

Study on the growth of summer shoots of the oak (*Quercus acutissima* Carr.) by cutting branches. (Etude de la croissance des rameaux du chêne (*Quercus acutissima* Carr.) en été après élagage.)

Canye Kexue, 1984, 10(2), p. 109. (C) R

REN D., et al.

The effect of temperature on the formation of the callus of mulberry trees. (Effet de la température sur la formation du cal du mûrier.)

Canye Kexue, 1984, 10(1), p. 6. (C) R

SATO M., TSUKAMOTO M.

Measurement of sap flow rate in mulberry shoot by heat pulse method. (Mesure du taux d'écoulement de la sève dans les rameaux de mûrier par la méthode des impulsions de chaleur.)

J. Seric. Sci. Jpn., 1984, 53(3), p. 251-252. (J) R

SHENTU GUANGREN, et al.

Integrated study on controlling mulberry mites by propargite. (Etude intégrée du contrôle des mites du mûrier par la propargite.)

Canye Kexue, 1984, 10(3), p. 134-138. (C) R

SHIRATA A., TAKAHASHI K.

Studies on phytoalexins of the Moraceae. 14) Structure of two stress metabolites, spirobroussonin A and spirobroussonin B from diseased paper mulberry. (Etudes sur les phytoalexines des Moracées. 14) Structure de deux métabolites chargés, la spirobroussine A et la spirobroussine B provenant du mûrier à papier malade.)

Chemistry letters, 1984, 5, p. 693.

SUZUKI T.

Total nitrogen and free amino acids in *Morus alba* stems from autumn through spring. (Azote total et acides aminés libres dans les tiges de *Morus alba*, du printemps à l'automne.)

Physiologia Plantarum, 1984, 60, p. 473.

SUZUKI T.*, KOHNO K.

Free amino acids in upper leaves of *Morus* species and their exudates after pruning during the growing season. (Les acides aminés libres dans les feuilles des cîmes du mûrier et dans leurs exsudats après la taille pendant la période de croissance.)

J. Seric. Sci. Jpn., 1984, 53(3), p. 216-221. (J,j,e) R

In all the varieties of *Morus* species employed (8 varieties of *Morus bombycis* Koidz., 8 varieties of *Morus alba* L. and 10 varieties of *Morus Lohu* (Ser.) Koidz), asparagine was quantitatively the major amino acid of exudates after stem-pruning. Smaller amounts of glutamine, aspartic acid and glutamic acid were also found, but other amino acids were scarcely detected. Asparagine was the predominant free amino acid in the upper leaves of the *Morus* species, when determined in late May and late August. Proline, glutamic acid, glutamine and pipecolic acid were also the main amino acids of the growing upper leaves. Free amino acids were decreased in late October, except for leucine, isoleucine and valine. The importance of asparagine in nitrogen nutrition and metabolism in *Morus* species during the growing season is discussed.

Chez toutes les variétés de mûrier utilisées (8 variétés de *Morus bombycis* Koidz, 8 variétés de *Morus alba* L. et 10 variétés de *Morus Lohu* (Ser.) Koidz), l'asparagine est l'acide aminé le plus important en quantité dans les exsudats après la taille. Des quantités moins importantes de glutamine, d'acide aspartique et d'acide glutamique sont détectées, ainsi que d'autres acides aminés, mais en quantités infimes. L'asparagine est l'acide aminé prédominant dans les feuilles de la cîme du mûrier, à la fin mai et à la fin août. La proline, l'acide glutamique, la glutamine et l'acide pipécolique constituent les principaux acides aminés des feuilles des cîmes pendant leur croissance. Les acides aminés libres, à l'exception de la leucine, de l'isoleucine et de la valine, diminuent à la fin du mois d'octobre. L'importance de l'asparagine dans la nutrition et le métabolisme de l'azote chez le mûrier pendant la croissance est discutée.

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TAKASUGI M., NIINO N., NAGAO S., ANETAI M., et al.

Studies on phytoalexins of the Moraceae. 13) 8 minor phytoalexins from diseased paper mulberry. (Etudes sur les phytoalexines des Moracées. 13) 8 phytoalexines mineures provenant du mûrier à papier.)

Chemistry letters, 1984, 5, p. 689.

YAMASHITA T.

Changes in contents of adenine nucleotides and development of ribulose biphosphate carboxylase activity during shooting of mulberry saplings. (Variations du contenu en nucléotides de l'adénine et développement de l'activité de la ribulose diphosphate carboxylase pendant la formation des rameaux chez les jeunes plants de mûrier.)

Plant Cell Physiol., 1983, 24, p. 1151-1155. (E)

YAMASHITA T.

Changes in the content of amino acids, carbohydrates and adenine nucleotides following budding in the hardwood stems of mulberry plants (*Morus alba*). (Variations du contenu en acides aminés, hydrates de carbone et nucléotides de l'adénine consécutives au bourgeonnement chez les tiges ligneuses des plants de mûrier (*Morus alba*).)

Annals of Botany, 1984, 54, p. 283.

YANG J., et al.

Studies on breeding the mulberry by radiation. 3) Induced polyploid mutant and its identification. (Etudes sur la sélection du mûrier au moyen de radiations. 3) Induction et identification d'un mutant polyploïde.)

Canye Kexue, 1984, 10(1), p. 9. (C) R

YE W.

A method of propagating mulberry saplings by indoor bud grafting. (Méthode de multiplication des plants de mûrier par greffe en écusson effectuée en intérieur.)

Canye Kexue, 1984, 10(1), p. 53. (C) R

YOKOYAMA T., OKA S., YAMADA K.

Frost hardiness and ability to freezing storage in mulberry shoots collected in the early spring. (Résistance au gel et aptitude pour la conservation par le froid chez les rameaux de mûrier récoltés au printemps.)

J. Seric. Sci. Jpn., 1984, 53(2), p. 179. (J) short report. R

ZAKARASHVILI T.N., PRIMA V.I., PANCHENKO L.P., SKRIPAL I.G.

DNA hybridization of mycoplasma strains which are agents of mulberry dwarf disease. (Hybridation d'ADN des souches de mycoplasmes qui sont des agents causals du nanisme du mûrier.)

Mikrobiol. Zh. (Kiev), 1984, 46(1), p. 30-32. (R)

ZHAO XUEFENG, et al.

The correlation of DNA content in mulberry leaves with mulberry varieties. (Corrélation entre le contenu en ADN des feuilles de mûrier et les différentes variétés de mûrier.)

Canye Kexue, 1984, 10(3), p. 182-183. (C) short report. R

ZHU B., et al.

An improved method of extracting MLO from the yellow dwarf diseased mulberry and the observation of its morphology. (Méthode améliorée pour extraire le MLO du mûrier atteint de nanisme jaune et observation de sa morphologie.)

Canye Kexue, 1984, 10(1), p. 13. (C) R

BOMBYX ELEVAGE / BOMBYX REARING

DUAN J.

A preliminary report on resistance of *Bombyx mori* larvae infected with cytoplasmic polyhedrosis virus. (Rapport préliminaire sur la résistance des larves de *Bombyx mori* infectées avec le virus de la polyédrose cytoplasmique).

Canye Kexue, 1984, 10(1), p. 29. (C) R

ENOKIJIMA M., YAMAMOTO T.

Effect of knobbed gene (K) on amount of food ingested, amount of food digested, cocoon weight and cocoon shell weight in the silkworm *Bombyx mori*, reared on artificial diet. (Effet du gène "bosselé" (K) sur la quantité de nourriture ingérée, la quantité de nourriture digérée, le poids du cocon et le poids de la coque soyeuse chez le ver à soie *Bombyx mori* élevé sur aliment artificiel).

J. Seric. Sci. Jpn, 1984, 53(3), p. 241-244. (J,j) R

FURUSAWA T., MITSUDA K., IKUTA M., SHIKATA M.

The artificial diets for the parent silkworm for hybridization, containing the homogenized mulberry leaves and chlorella. (Les aliments artificiels pour les vers à soie parentaux destinés à l'hybridation, contenant des feuilles de mûrier et des chlorelles homogénéisées.)

Bul. Fac. Text. Sci. Kyoto Univ., 1984, 10(3), p. 335-357. (J,j,e) R

In order to improve the artificial diets for rearing the parent silkworm for hybridization, the diets made of homogenized mulberry leaves (HML) and chlorella (CHL) were prepared. Rearing experiments of silkworm larvae and the quantitative assessment of cocoon characters and egg productivity of the silkworm moth were undertaken. The results were summarized as follows.

1) The artificial diets containing HML, and soybean powder (SOY) or chlorella as a protein source were available for rearing the parent silkworm. The period of younger larvae development on the diets containing CHL or an equal weight of CHL and SOY was shorter than that on mulberry leaves or commercial artificial diets (T). The body weight of these newly ecdysed 5th instar larvae was less than those on mulberry leaves, but more than those on a T diet.

2) When the hybrid race and the parent silkworm were reared on mulberry leaves powder (MLP) or HML supplemented with an equal weight of SOY and CHL, the weight of cocoon and its shell produced by these silkworms was larger than that produced on the diets containing only SOY or CHL. Similar relationships were observed concerning egg productivity. Furthermore, there was no difference in egg productivity, whether the younger silkworm larvae were reared on HML, MLP containing an equal weight of SOY and CHL, or a T diet.

3) When Wesson's mineral and vitamin B mixture were supplemented to the diets of HML or MLP, which contained an equal weight of SOY and CHL, the weight of the cocoon and its shell was larger than that produced by the larvae on the diets without minerals and vitamin B mixture. Similar relationships were observed regarding egg productivity.

4) From these results, the advantages of employing HML and an equal mixture of CHL and SOY for the preparation of the artificial diets for rearing the parent silkworm were discussed.

Pour améliorer les aliments artificiels destinés à l'élevage de vers à soie futurs reproducteurs, des aliments sont préparés à partir de feuilles de mûrier homogénéisées (FMH) et de chlorelles (CHL). Un élevage expérimental des larves de ver à soie a été entrepris pour évaluer les caractères quantitatifs des cocons et la production d'oeufs par les papillons. Les résultats sont résumés ci-dessous.

1) Les aliments artificiels contenant des FMH, et du soja en poudre (SOY) ou des chlorelles comme source de protéines sont disponibles pour les vers à soie reproducteurs. La période de développement des jeunes larves nourries avec l'aliment contenant CHL ou un poids égal de CHL et SOY, est plus courte que chez les larves nourries avec des feuilles de mûrier ou des aliments artificiels commerciaux (T). Le poids corporel de ces larves du 5ème âge sortant de mue est inférieur à celui des larves nourries avec les feuilles de mûrier, mais supérieur à celui des larves nourries avec l'aliment T.

2) Lorsque les hybrides et les souches parentales sont élevés avec des feuilles de mûrier en poudre (FMP) ou avec des feuilles de mûrier homogénéisées, additionnées d'un poids égal de SOY et de CHL, le poids du cocon et de la coque soyeuse produits par ces vers à soie est supérieur à celui obtenu avec les aliments contenant uniquement du SOY ou de la CHL. Des corrélations similaires sont observées pour ce qui concerne la production d'oeufs. De plus, on n'observe pas de différences dans la production d'oeufs, que les jeunes larves soient nourries avec FMH, avec FMP contenant un poids égal de SOY et de CHL, ou avec un aliment T.

3) Quand on ajoute un mélange de minéraux de Wesson et de vitamine B aux aliments FMH ou FMP, contenant du SOY et CHL en quantités égales, le poids du cocon et de la coque soyeuse est supérieur à celui obtenu chez les larves élevées avec les aliments sans minéraux et vitamine B. Il en est de même pour la production d'oeufs.

4) Les avantages liés à l'emploi de FMH et d'un mélange de SOY et CHL en quantités égales pour confectionner les aliments artificiels des souches parentales, sont discutés en fonction de ces résultats.

GE H., et al.

Studies on the standard of optimum rearing temperatures for young silkworms. (Etudes sur les températures optimales pour l'élevage des jeunes vers à soie).

Canye Kexue, 1984, 10(1), p. 22. (C) R

HORIE Y., WATANABE K.

Design of the composition of the artificial diet for the silkworm, *Bombyx mori* by linear programming method : application of the ingredients of feeds for domesticated animals and fowls. (Détermination de la composition de l'aliment artificiel pour le ver à soie *Bombyx mori* par une méthode de programmation linéaire : application pour les ingrédients des aliments des animaux domestiques).

Bull. Sericult. Exp. Station, 1984, 29(2), p. 259-283. (J,j,e) R

HU X., et al.

Studies on infectivity of silkworm densovirus to some silkworm races. (Etudes sur l'infectivité du virus de la denso-nucléose sur certaines races de vers à soie).

Canye Kexue, 1984, 10(2), p. 87. (C) R

HUANG E.

Studies on the biology and utilization of the *Apanteles femoratus* Ashmead., an important larval parasite of the mulberry tussock moth *Euproctis similis* Fuessly. (Etudes biologiques et utilisation de *Apanteles femoratus* Ashmead., parasite larvaire important de l'orgyie du mûrier, *Euproctis similis* Fuessly).

Canye Kexue, 1984, 10(1), p. 16. (C) R

HUANG Z., et al.

Studies on radiation sterile technique in controlling parasitic flies (*Exorista sorbillans* Wied.) of the silkworm *Bombyx mori* L. 3) Effects of release of sterilized flies in controlling the parasitic flies of silkworm, and the influence upon the population of the flies in field. (Etudes sur la technique de stérilisation par radiation pour le contrôle des mouches (*Exorista sorbillans* Wied.) parasites du ver à soie *Bombyx mori*. 3) Effets du lâcher de mouches stérilisées sur le contrôle des mouches parasites du ver à soie et son influence sur la population des mouches dans leur milieu naturel).

Canye Kexue, 1984, 10(1), p. 52. (C) R

KATO Y., KUBO M., WAKU Y., HAYASHIYA M., et al.

Mechanism of insecticidal action of deoxypodophyllotoxin (Athracin). 2) Histopathological studies on tissues of silkworm larvae intoxicated by deoxypodophyllotoxin. (Mécanisme de l'action insecticide de la déoxypodophyllotoxine (Athrachine). 2) Etudes histopathologiques des tissus de larves de ver à soie intoxiquées par la déoxypodophyllotoxine).

Chem. Pharm. Bulletin, 1984, 32, p. 2015

KAWAKAMI K., MIKUNI T.

On the susceptibility of larvae of the silkworm, *Bombyx mori*, reared on artificial diets to the infection with muscardine fungi. (Sensibilité à la muscardine des larves de ver à soie *Bombyx mori* nourries sur aliments artificiels).

J. Sericult. Sci. Japan, 1984, 53(3), p. 245-249. (J.) R

In view of control of muscardine diseases of the silkworm, the susceptibility of larvae, reared either on artificial diets or mulberry leaves, to fungus infection was investigated. Two kinds of artificial diets were used for silkworm rearing in the experiment. Fungus species used were *Beauveria bassiana*, *Metarhizium anisopliae*, and *Nomuraea rileyi*. Susceptibilities of larvae to fungus infection were tested by means of topical applications of fungus conidia on integument of 3rd instar or 4th instar larvae, injection of conidial suspension into body cavity of 4th instar larvae and slide culture for germination of fungus conidia in the blood from the larvae. The results of these experiments showed that there was no difference in the susceptibility to infection with muscardine fungi between the larvae reared on artificial diets and those reared on mulberry leaves. It is thus necessary to carry out the control of muscardine diseases by usual methods.

Afin de contrôler la muscardine du ver à soie, nous avons étudié la sensibilité aux champignons des larves nourries sur aliments artificiels ou sur feuilles de mûrier. Nous avons utilisé deux types d'aliments artificiels. Les espèces de champignons utilisés étaient : *Beauveria bassiana*, *Metarhizium anisopliae*, et *Nomuraea rileyi*. Les sensibilités des larves à l'infection des champignons ont été testées par des applications topiques de conidies sur le tégument des larves du 3ème ou 4ème âge.

des injections de suspensions de conidies aux larves du 4ème âge et la culture sur lamelle pour la germination des conidies dans l'hémolymphe des larves. Les résultats de ces expériences montrent qu'il n'y a pas de différence de sensibilité à la muscardine entre les larves nourries sur aliments artificiels et celles nourries sur feuilles de mûrier. Il est donc nécessaire d'effectuer le contrôle de la muscardine par les méthodes habituelles.

Sericultural Experiment Station, Yatabe, Ibaraki 305, Japan.

KAWAKAMI S., MORISAKI M., IKEKAWA N.

Nutritional effects of some cholestenols and cholestadienols on the silkworm *Bombyx mori*. (Conséquences nutritionnelles de certains cholesténols et cholestadiénols sur le ver à soie *Bombyx mori*).

Chem. Pharm. Bulletin, 1984, 32, p. 1608.

KURISU K., NAKAO T., HAMASAKI M.

Studies on the pebrine inspection of the mother in the silkworm, *Bombyx mori*, for the commercial eggs. 2) Fundamental studies on the sampling inspection plan. (Etudes sur la détection de la pébrine chez les vers à soie femelles de *Bombyx mori* pour la commercialisation des graines. 2) Etudes fondamentales sur le projet de détection sur échantillon).

Bull. Faculty Textile Sci. (Kyoto University), 1984, 10(3), p. 313-324. (J,j,e) R

MATSUBARA F., GO Y., KAWAGUCHI M., MORI H.

Aseptic rearing of silkworms on an artificial diet by only one feeding. (Elevage aseptique de vers à soie nourris avec un aliment artificiel distribué en une seule fois.)

Bul. Fac. Text. Sci. Kyoto Univ., 1984, 10(3), p. 359-363. (J,j,e) R

Silkworm eggs were disinfected on the day before hatching by the standard method (Matsubara, 1975). Ten hatched larvae were placed on the artificial diet (80g of dried diet was mixed in 192ml of water, spreaded flatly in the petri dish and autoclaved for sterilization at 117°C for 40 minutes) in a petri dish with a diameter of 18cm. A piece of netting was placed over the silkworm and the lid was placed on the petri dish, which was then transferred to a germ-free box. The silkworms were reared aseptically under continuous light or darkness at 25°C during the whole larval stage without changing the diet.

The silkworms grew well and uniformly, and they proceeded from the 1st to 4th instar at about the same rate as the controls (aseptically reared on four feedings during the whole larval stage). But the 5th stage was a little longer than for the controls. None of the silkworms died and they began to spin their threads and to make cocoons after about 31 days from the beginning of rearing. The percentage of pupation and eclosion was 85% or more. The weight of the silkworm and results of cocoon inspection (total cocoon weight, weight of cocoon layer) were similar to those of the controls.

Les oeufs de ver à soie sont désinfectés la veille de l'éclosion par la méthode standard (Matsubara, 1975). Dix larves sont élevées avec l'aliment artificiel (80 gr d'aliment sec sont mélangés à 192 ml d'eau, étalés dans une boîte de Petri et stérilisés à 117°C pendant 40 minutes) dans une boîte de Petri de 18 cm de diamètre. Un filet est placé sur les vers à soie et un couvercle est mis sur la boîte de Petri, qui est ensuite placée dans une boîte aseptisée. Les vers à soie sont élevés en aseptie sous lumière continue ou obscurité à 25°C pendant tout le stade larvaire sans changer l'aliment.

Les vers à soie grandissent bien, et de manière uniforme, et passent du 1er au 4ème âge en même temps que les vers témoins (élevés en aseptie avec quatre distributions de nourriture pendant tout le stade larvaire). Mais le 5ème âge est un plus long que chez les vers à soie témoins. Aucun des vers à soie n'est mort, et ils commencent à filer et à faire leur cocon 31 jours environ après le début de l'élevage. Le pourcentage de pupaison et d'émergence est de 85 % ou plus. Le poids du ver à soie et les résultats de l'examen des cocons (poids total du cocon, poids de la coque soyeuse) sont semblables à ceux obtenus chez les vers témoins.

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MATSUMOTO T., OHNISHI M., MATSUBARA F., KOHNO K.

Microbiological certification of aseptically reared silkworm larvae on artificial diet during early developmental stages (1979-1982). (Certification microbiologique de larves de ver à soie élevées en aseptie sur aliment artificiel pendant les premiers stades du développement (1979-1982).)

Bul. Fac. Text. Sci. Kyoto Univ., 1984, 10(3), p. 365-371. (J,j,e) R

A caring test of microbes against aseptically reared *Bombyx* larvae which were fed on artificial diet during early developmental stages was performed. The microbic healthy inspections against these larvae were done in order to apply an aseptic rearing method in a new sericultural system. On switching to being reared on mulberry leaves, the tests were practiced by agarplate and aseptic culture methods. A total of 417 groups in 23 rearing seasons was examined from 1979 to 1982. In nine rearing seasons, the microbes in larvae were detected by the methods used in this study. Bacterial genera of *Bacillus*, *Staphylococcus*, *Streptococcus*, *Pseudomonas* and *Klebsiella* and fungus of *Penicillium*, *Cladosporium*, *Aspergillus*, *Artanaria*, *Fusarium* and yeast were isolated from those detected microbes. The high frequency of *Bacillus*, *Penicillium* and *Cladosporium* was present.

A virological test by microscopic observation of polyhedra in nuclear polyhedrosis virus and cytoplasmic polyhedrosis virus, and by immunological methods in infectious flacherie virus was also performed against some aseptically reared larvae. No virus was detected throughout the entire rearing season.

Un test de salubrité microbiologique est effectué sur des larves de *Bombyx* élevées en aseptie sur aliment artificiel pendant les premiers stades de développement. L'inspection microbiologique de ces larves est faite pour mettre en oeuvre une méthode d'élevage aseptique dans un nouveau système séricicole. Les tests sont pratiqués par culture sur gélose en aseptie. Au total, 417 groupes de 23 saisons d'élevage différentes furent examinés entre 1979 et 1982. Pour 9 saisons d'élevage, des microbes ont été détectés sur les larves par la méthode utilisée. A partir de ces détectations, nous avons identifié les genres bactériens *Bacillus*, *Staphylococcus*, *Streptococcus*, *Pseudomonas*, et *Klebsiella*, les champignons de *Penicillium*, *Cladosporium*, *Aspergillus*, *Artanaria*, *Fusarium* et des levures. *Bacillus*, *Penicillium* et *Cladosporium* sont très souvent présents.

Nous avons également effectué un test virologique par observation au microscope pour la détection des polyèdres du virus de la polyédrose nucléaire et du virus de la polyédrose cytoplasmique, et un test immunologique pour détecter le virus de la flacherie infectieuse. Aucun virus n'a été détecté à aucun moment de la saison d'élevage sur les larves élevées en aseptie.

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MATSUZAKI H.

Studies on the preliminary treatment in cocoon cooking (V) On the solubility of cocoon shells treated with buffer solution of the dibasic organic acids. (Etude du traitement préliminaire à la cuisson des cocons (V) Solubilité des coques soyeuses traitées avec une solution tampon d'acides organiques dibasiques).

Reports of the Silk Sci. Res. Inst. (Japan), 1984, 32, p. 43-52. (J,j,) R

MIURA M.

Statistical analysis of the relationship between feeding ends and dropping ends. (Analyse statistique de la relation entre les jetées de bout et les cassures).

J. Sericult. Sci. Japan, 1984, 53(2), p. 156-159. (J,j,e) R

Statistical model was presented to determine the ratio of feeding ends caused directly by dropping ends. Using this model, an equation was derived which gave the relationship between its ratio and the properties of cocoons. The results showed that the ratio was determined only by both distributions of the size of first and last portion of cocoon filaments when good cocoons were reeled.

Un modèle statistique a été présenté pour déterminer le taux de jetées de bout causé directement par cassures. En utilisant ce modèle, nous avons obtenu une équation qui donne la relation entre ce taux et les propriétés des cocons. Les résultats montrent que le taux est déterminé uniquement par la distribution de la taille des extrémités des filaments du cocon lorsque des bons cocons sont dévidés.

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NITTA M., WATANABE H.

Effects of formalin on characteristics of nuclear polyhedra of the silkworm, *Bombyx mori*. (Effets de la formoline sur les caractéristiques des polyèdres nucléaires du ver à soie *Bombyx mori*).

J. Sericult. Sci. Japan, 1984, 53(2), p. 146-150. (J,j,e) R

A formalin treatment made nuclear polyhedra of the silkworm, *Bombyx mori*, hard to soluble in alkaline solution or digestive juice from the larvae. Sodium dodecyl sulfate (SDS)-polyacrylamide gel electrophoresis of the formalin-treated polyhedral protein revealed a pattern indicating fixation of protein. Alkaline protease present in the polyhedra was also inactivated by the formalin treatment. However, the solubility and the protease activity of polyhedra were recovered when they were kept in distilled water or 0.05 M Tris-HCl buffer (pH 7.6)-0.05 M NaCl.

Un traitement à la formoline rend les polyèdres nucléaires du ver à soie *Bombyx mori* difficiles à dissoudre dans une solution alcaline ou dans le suc digestif des larves. L'électrophorèse sur gel de polyacrylamide-SDS des protéines de polyèdres traitées à la formoline donne un profil indiquant la fixation de protéine. La protéase alcaline présente dans les polyèdres est inactivée par le traitement à la formoline. Cependant, la solubilité et l'activité des protéases des polyèdres réapparaissent lorsqu'elles sont conservées dans de l'eau distillée ou dans un tampon Tris-HCl 0,05 M, NaCl 0,05 M à pH 7,6.

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NOGUCHI Y.

Histopathological observations on the midgut epithelia of lepidopterous insects naturally recovered from infection by a cytoplasmic-polyhedrosis virus of the silkworm, *Bombyx mori*. (Observations histopathologiques sur l'épithélium de l'intestin moyen des insectes lépidoptères ayant subi une infection par un virus de la polyédrose cytoplasmique du ver à soie *Bombyx mori*).

J. Sericult. Sci. Japan, 1984, 53(2), p. 141-145. (J,j,e) R

Electron microscopical observations were performed on the midgut epithelia from *Hyphantria cunea* and *Orgyia thyellina* larvae infected with a *Bombyx* cytoplasmic virus (CPV). In the midgut epithelial cells of those insects, empty capsids of *Bombyx* CPV were increased in number, whereas normal virus replication and development of virogenic stroma were suppressed. In the renewed epithelial cells which had been regenerated after the infected cells were discharged into the gut lumen, no histopathological lesion by virus infection was observed. In a few cells immediately after regeneration, however, virogenic stroma of small size were observed where empty capsids were assembled. Further, polyhedron protein and *Bombyx* CPV were not detected in the renewed cells by immunofluorescence technique. These results suggested that the renewed cells might acquire an ability to prevent the replication of *Bombyx* CPV.

Des observations au microscope électronique ont été effectuées sur l'épithélium de l'intestin moyen des larves de *Hyphantria cunea* et de *Orgyia thyellina* infectées par le virus de la polyédrose cytoplasmique du *Bombyx* (CPV). Dans les cellules de l'épithélium de l'intestin moyen, les capsides vides du CPV de *Bombyx* se sont multipliées tandis que la multiplication et le développement du stroma virogénique ont cessé. Chez les nouvelles cellules de l'épithélium qui s'étaient régénérées après l'évacuation des cellules infectées dans le lumen de l'intestin, aucune lésion histopathologique due à l'infection virale n'a pu être observée. Cependant, nous avons observé, immédiatement après la régénération, que quelques cellules avaient des stroma virogéniques de petite taille là où les capsides vides étaient assemblés. De plus, l'immunofluorescence n'a pas permis de détecter chez les nouvelles cellules la protéine du polyédron et le CPV du *Bombyx*. Ces résultats suggèrent que les nouvelles cellules acquièrent la capacité d'empêcher la multiplication du CPV de *Bombyx*.

QIAN D., LI Z., WANG J., GAO X.

Fluoride and mulberry silkworm ecosystem. (Fluoride et écosystème du ver à soie du mûrier).

Huanjing Kexue, 1984, 5(1), p. 7-11. (C) R

QIAN Y. et al.

Studies on the practicability of serological diagnosis of virus disease of the silkworm (*Bombyx mori* L.). Dry storage of antiserum paper. (Etude sur la praticabilité d'un diagnostic sérologique des maladies virales du ver à soie (*Bombyx mori* L.) Conservation au sec du papier anti-sérum).

Canye Kexue, 1984, 10(3), p. 155-157. (C) R

SHIKATA M., FURUSAWA T., SUZUKI T.

Feeding responses in silkworm larvae to the ether methanol and hot water extracts from the dry powder of mulberry leaves of different leaf order. (Réponses alimentaires des larves de ver à soie aux extraits d'éther, de méthanol et d'eau chaude de poudre sèche de mûrier provenant de différents niveaux).

Bull. Faculty Textile Sci. (Kyoto Univ.), 1984, 10(3), p. 325-333. (J,j,e) R

In experiments concerning the feeding responses of newly hatched silkworm larvae to the dried powder of mulberry leaves from the upper and the lower order, the silkworm larvae exhibited preferential feeding responses to the upper leaves than the lower ones, suggesting a possible presence of feeding stimulant(s) in the powder from upper leaf order.

In order to find out what substance(s) were present, extracts with ether, methanol and hot water of mulberry leaf powder of upper and lower orders were tested for the feeding response.

In ether differences in the phagostimulative effects could not be detected between the upper and lower leaves. However, there was a difference in the hot water extract and the distillate from the 80% hot methanol extract.

Furthermore, it was discussed that in addition to feeding stimulants, there might be feeding deterrents in the dried mulberry leaf powder of the lower order.

Les expériences sur les réponses alimentaires des larves de ver à soie nouvellement écloses à la poudre de feuilles de mûrier provenant de feuilles d'ordre inférieur et supérieur, montrent que les larves ont une préférence pour les feuilles d'ordre supérieur, ce qui suggère la présence possible de stimulant(s) dans la poudre de feuille d'ordre supérieur.

Afin de déterminer les substances présentes, nous avons testé les extraits d'éther, de méthanol et d'eau chaude de la poudre de feuilles de mûrier d'ordre inférieur et supérieur.

Dans le cas d'extraits d'éther, nous n'avons pas détecté de différence d'effet stimulant entre les feuilles de niveau inférieur et celles de niveau supérieur. Cependant nous avons noté une différence pour l'extrait d'eau chaude et pour le distillat de l'extrait de méthanol chaud à 80%.

En plus des stimulants alimentaires, il pourrait y avoir dans la poudre sèche des feuilles de mûrier d'ordre inférieur, des dissuasifs alimentaires.

TANAKA Y., MIDORIKAWA E.

Breeding of "To-ichi-go" and "Kaiichi-go", the strains suitable for artificial diet rearing. (Sélection de "To-ichi-go" and "Kaiichi-go", deux souches convenant à l'élevage sur milieu artificiel).

Reports of the Silk Sci. Res. Inst., 1984, 32, p. 31-42. (J,j,e) R

TANG LIANGYU et al.

Quantitative analysis of fluorides accumulated in the silkworm body as a result of atmospheric fluorine pollution. (Analyse quantitative des fluorures accumulés dans le corps du ver à soie suite à la pollution de l'atmosphère par les fluors).

Canyo Kexue, 1984, 10(3), p. 173-177. (C) R

TANG WENYUE et al.

Study on the selective direction of the resistance to CPV in the silkworm (*Bombyx mori* L.). (Etude sur l'orientation sélective de la résistance au CPV chez le ver à soie *Bombyx mori* L.).

Canyo Kexue, 1984, 10(3), p. 163-168. (C) R

UOZUMI M., KOSAKA H., NOGAMI H., OHYAMA M. et al.

Quantitative study on the biological effect of environmental pollutants. 2) Effect of nitrogen dioxide on silkworm. (Etude quantitative des conséquences biologiques des polluants de l'environnement. 2) Effet du dioxyde d'azote sur le ver à soie).

Osaka-furitsu Koshu, Eisei Kenkyusho Kenkyu Hokoku, Kogai Eisei Hen, 1983, 4, p. 7-9.

WATANABE H.

Effects of an antibiotic on polyhedrosis-virus infection in the silkworm, *Bombyx mori*, reared on an artificial diet. (Effets d'un antibiotique sur l'infection provoquée par le virus de la polyédrose chez le ver à soie *Bombyx mori* élevé sur aliment artificiel.)

J. Seric. Sci. Jpn., 1984, 52(2), p.160-164. (J,j,e) R

The susceptibility and the lethal time of infection by a nuclear polyhedrosis virus (NPV) were almost the same between silkworm larvae reared on artificial diets with or without containing of an antibiotic, chloramphenicol, indicating the antibiotic in artificial diet had no effect on NPV infection and multiplication in the fed larvae. On the other hand, the antibiotic in diet was greatly effective to prolong the lethal time of the fed larvae infected with a cytoplasmic-polyhedrosis virus (CPV). The prolongation of life was mainly due to the fact that the antibiotic in diet almost suppressed the abnormal multiplication of intestinal bacteria in the mid-gut lumen, which was usually accompanied by CPV infection.

La prédisposition et la période létale de l'infection provoquée par un virus de la polyédrose nucléaire (NPV) sont presque identiques chez les vers à soie élevés sur aliment artificiel, que l'aliment contienne ou non un antibiotique (chloramphénicol) ce qui montre que l'antibiotique incorporé dans la nourriture artificielle n'a aucun effet sur le virus de la polyédrose nucléaire et sa multiplication chez les larves. Cependant, l'antibiotique incorporé dans la nourriture est très efficace pour repousser la période létale des larves infectées par le virus de polyédrose cytoplasmique (CPV). La prolongation de vie est principalement due au fait que l'antibiotique dans la nourriture supprime presque complètement la multiplication anormale de bactéries intestinales dans le lumen de l'intestin moyen qui est habituellement accompagnée de l'infection CPV.

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XU HOURONG et al.

Preliminary report on the identification of the adaptive faculty of mutual adaptableness between some new silkworm varieties and mulberry varieties. (Rapport préliminaire sur la faculté adaptative mutuelle de quelques lignées du ver à soie et de mûriers).

Canye Kexue, 1984, 10(3), p. 150-154. (C) R

BOMBYX BIOLOGIE / BOMBYX BIOLOGY

AKAI H.

The effects of juvenile hormone treatment on the structure and synthetic activity of the silk gland of *Bombyx mori*. (Effets du traitement à l'hormone juvénile sur la structure et l'activité de synthèse de la glande séricigène de *Bombyx mori*).

In : Ultrastructure Funct. Insect Cells, Proc. Int. Conf., 1982, ed. by H. Akai, R.C. King, S. Morehoshi ; Publ. Bus. Center Acad. Soc. Japan, Tokyo., p. 143-148. (E)

BANDO H., KONDO N., KAWASE S.

Molecular homology among the structural proteins of densovirus from silkworm, *Bombyx mori*. (Homologies moléculaires entre les protéines structurales du virus de la densovirus provenant du ver à soie *Bombyx mori*).

Archives of Virology, 1984, 80, p. 209. (E)

BJOSTAD L.B., ROELOFS W.L.

Sex pheromone biosynthetic precursors in *Bombyx mori*. (Précurseurs biosynthétiques de la phéromone sexuelle chez *Bombyx mori*).

Insect Biochemistry, 1984, 14, p. 275.

DOIRA H.*, MIYA K.*, KIHARA H.*

Linkage studies on the "Star-spots duplication" mutant of *Bombyx mori*. (Etude de linkage chez le mutant de *Bombyx mori* "duplication des stars").

J. Sericult. Sci. Japan, 1984, 53(3), p. 237-240. (J,j,e) R

Linkage analysis of the "Star-spots duplication" gene (symbol, *Dus*) was performed. Mating experiment revealed that the *Dus* gene was linked with white-egg 2 (*w-2*) and dwarf-k (*dw-k*) which had been mapped at 16.1 and 0.0 position, respectively, on the tenth linkage group. A three-point experiment involving *dw-k*, *w-2* and *Dus* was made in order to determine map position of the *Dus* gene. The recombination value between *dw-k* and *Dus* was 4.27%, *Dus* - *w-2* 13.15% and *dw-k* - *w-2* 16.98%. Taking correction factor in account, the locus of *Dus* was calculated to be 3.94 units away to the right of *dw-k*. Hence the *Dus* gene is localized at 3.9 on the tenth linkage group.

Nous avons effectué une analyse de linkage du gène "duplication des stars" (symbole *Dus*). Les expériences d'accouplement indiquent que le gène *Dus* est lié aux gènes oeuf-blanc 2 (*w-2*) et nain-k (*dw-k*) qui ont été localisés sur la carte de liaison aux positions 16,1 et 0,0 du 10ème groupe. Une expérience en 3 points comportant *dw-k*, *w-2* et *Dus* a été faite pour déterminer la position du gène *Dus* sur la carte. La valeur de recombinaison entre *dw-k* et *Dus* est de 4,27 %, elle est de 13,15 % entre *Dus* et *w-2* et de 16,98 % entre *dw-k* et *w-2*. En tenant compte du facteur de correc-

tion, nous avons calculé que le locus de *Dus* se trouve à 3,94 unités à droite de *dw-k*. Le gène *Dus* est donc localisé à 3,9 sur le 10ème groupe de linkage.

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DU H. et al.

Studies on serological typing of *Pseudomonas mori*. (Etudes des types sérologiques de *Pseudomonas mori*).

Canye Kexue, 1984, 10(2), p. 72. (C) R

EGUCHI M.

Protease inhibitor in the haemolymph of silkworm (Inhibiteur de protéase dans l'hémolymph du ver à soie).

Kagaku to Seibutsu, 1983, 21(10), p. 631-632. (J)

EGUCHI M., SHOMOTO K.

Comparison of five chymotrypsin inhibitors from the silkworm haemolymph. (Comparaison de cinq inhibiteurs de chymotrypsine provenant de l'hémolymph du ver à soie).

Comp. Biochem. Physiol., 1984, 78, p. 723. (E)

FOURNIER A., GUERIN M.A., CORLET J., CLARKSON S.G.

Structure and *in vitro* transcription of a glycine tRNA gene from *Bombyx mori*. (Structure et transcription *in vitro* d'un gène de tRNA glycine de *Bombyx mori*.)

The EMBO Journal, 1984, 3(7), p. 1547-1552. (E,e) R

We report the sequences of a *Bombyx mori* tRNA^{Gly} gene, its flanking regions, and its *in vitro* transcription products. The 5' flanking DNA contains the sequences TATAC, TATTTT and TTC located 30, 18 and 4 nucleotides, respectively, in front of the transcription initiation site. These resemble, in both position and composition, sequences preceding other RNA polymerase III genes of *B. mori*. A deletion mutant retaining these conserved sequences and an additional 8bp of flanking DNA is transcribed better than the wild-type gene in cell-free extracts from *Xenopus laevis* and *B. mori*. A mutant lacking the conserved sequences is expressed in the frog extract, but is inactive in the homologous system.

Nous communiquons la séquence d'un gène de tRNA^{Gly} de *Bombyx mori*, de ses régions flanquantes, et les produits de sa transcription *in vitro*. L'ADN de la région flanquante en 5' contient les séquences TATAC, TATTTT et TTC situées respectivement à 30, 18 et 4 nucléotides, devant le site de début de la transcription. Celles-ci ressemblent, à la fois par leur position et leur composition, aux séquences qui précèdent d'autres gènes de *B. mori* transcrits par la RNA polymérase III. Un mutant de délétion conservant ces séquences et retenant un fragment supplémentaire de 8 paires de bases, est mieux transcrit que le gène de type sauvage dans les extraits acellulaires de *Xenopus laevis* et *B. mori*. Un mutant ne comportant pas les séquences conservées est exprimé dans l'extrait de grenouille, mais est inactif dans le système homologue.

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FUGO H., IWATA Y., NAKAJIMA M.

Eclosion hormone activity in haemolymph of eclosing silkworm, *Bombyx mori*. (Activité de l'hormone d'émergence dans l'hémolymph du papillon émergé de *Bombyx mori*.)

J. Ins. Physiol., 1984, 30, p. 471.

FUJIMORI H., SHIMIZU K., ENOKIJIMA M.

Chromosome mapping of the blood acid phosphatase gene in the silkworm, *Bombyx mori*. (Carte chromosomique du gène de la phosphatase acide de l'hémolymph chez le ver à soie *Bombyx mori*.)

J. Seric. Sci. Jpn., 1984, 53(2), p. 181. (J) short report. R

FUJIWARA H., OGURA T., TAKADA N., MIYAJIMA N., ISHIKAWA H., MAEKAWA H.*

Introns and their flanking sequences of *Bombyx mori* rDNA. (Les introns de l'ADN ribosomique de *Bombyx mori* et leurs séquences flanquantes.)

Nucleic Acids Research, 1984, 12(17), p. 6861-6869. (E,e) R

We obtained two different clones (16kb and 13kb) of *B. mori* rDNA with intron sequence within the 28S-rRNA coding region. The sequence surrounding the intron was found to be highly conserved as indicated in several eukaryotes (*Tetrahymena*, *Drosophila* and *Xenopus*). The 28S rRNA-coding sequence of 16 kb and 13 kb clone was interrupted at precisely the same sites as those where the *D. melanogaster* rDNA interrupted by the type I and type II intron, respectively. The intron sequences of *B. mori* were different from those of *D. melanogaster*. In 16 kb clone, the intron was flanked by 14 bp duplication of the junction sequence, which was also present once within the 28S rRNA-coding region of rDNA without intron. This 14 bp sequence was identical with those surrounding the introns of Dipteran rDNAs.

Nous avons obtenu deux clones différents (16 kb et 13 kb) d'ADNr de *B. mori* avec un intron dans la région codante pour l'ARNr 28S. La séquence qui entoure l'intron est hautement conservée comme indiqué chez plusieurs eucaryotes (*Tetrahymena*, *Drosophila* et *Xenopus*). La séquence codant pour le 28S des clones 16 kb et 13 kb est interrompue aux mêmes sites précisément que ceux où l'ADNr de *D. melanogaster* est interrompu par les introns de type I et de type II, respectivement. Les séquences d'intron de *B. mori* sont différentes de celles de *D. melanogaster*. Dans le clone de 16 kb, l'intron est flanqué par une duplication de 14 pb de la séquence de jonction, qui est également présente dans la région codant pour le 28S de l'ADNr sans intron. Cette séquence de 14 pb est identique à celles qui entourent les introns des ADNr de Diptère.

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GREGORY S.P.

The silk fibroin gene. (Le gène de la fibroïne.)

In : Eukaryotic genes: their structure, activities, regulation., 1983, ed. by Mc Lean N., Gregory S.P., Flavell R.A., published by Butterworth, London, p. 397-413. (E)

HAMANA K., MATSUZAKI S., INOUE K.

Changes in polyamine levels in various organs of *Bombyx mori* during its life cycle. (Variations des niveaux en polyamine chez les différents organes de *Bombyx mori* au cours de son cycle de vie.)

J. Biochem., 1984, 95, p. 1803. (E)

HUANG J.

Studies on the chromosome engineering and application in the *Bombyx mori* silkworm. 1) Produced translation between Z chromosome and W chromosome. (Etudes sur "l'ingénierie" des chromosomes et son application chez le ver à soie *Bombyx mori*. 1) Translation entre le chromosome Z et le chromosome W.)

Canye Kexue, 1984, 10(1), p. 34. (C) R

HUANG K., et al.

Studies on the technique of examination of polyhedra of cytoplasmic polyhedrosis virus of the silkworm (*Bombyx mori* L.), existing in soil. (Techniques d'examen des polyèdres du virus de la polyédrose cytoplasmique du ver à soie *Bombyx mori* L., existant dans la litière.)

Canye Kexue, 1984, 10(2), p. 91. (C) R

HUANG S., LI S., YANG L., YE W., et al.

Studies on esterase isoenzymes of different organs in *Bombyx mori*. (Etude des isoenzymes esterase de différents organes chez *Bombyx mori*.)

Dongwuxue Yanjiu, 1983, 4(4), p. 333. (C)

HYODO A., YAMAMOTO T., UEDA H., TAKEI F., et al.

Linkage analysis of the fibroin light chain gene in the silkworm *Bombyx mori*. (Analyse du linkage du gène de la chaîne légère de la fibroïne chez le ver à soie *Bombyx mori*.)

Japan J. Genetics, 1984, 59, p. 285.

IATROU K., TSITILIOUS G., KAFATOS F.C.

DNA sequence transfer between two high-cysteine chorion gene families in the silkworm *Bombyx mori*. (Transfert de séquence d'ADN entre deux familles de gènes du chorion à taux élevé en cystéine chez le papillon *Bombyx mori*.)

Proc. Natl. Acad. Sci. USA, 1984, 81, p. 4452-4456. (E,e) R

We have previously shown that one type of high-cysteine silkworm chorion protein (Hc-A) has evolved from the A family of chorion proteins by radical modifications of the NH₂-terminal and COOH-terminal polypeptide arms: most of the arm sequences have been deleted, while short cysteine- and glycine-containing repeats have expanded into long arrays. Strikingly similar modifications of the arms have led to the evolution of a second type of high-cysteine protein (Hc-B) from the B family of chorion proteins. It appears that the parallel evolution of these high-cysteine-encoding gene families has not been entirely independent: examination of 3' untranslated regions shows evidence of information transfer between the two families.

Nous avons précédemment montré qu'un type de protéine du chorion à taux élevé en cystéine (Hc-A) s'est formé à partir de la famille A des protéines du chorion, grâce à des modifications des bras des polypeptides N-terminal et C-terminal : la plupart des séquences des bras sont déléetées, tandis que de courtes répétitions contenant de la cystéine et de la glycine s'étendent en longues files. De façon étonnante, des modifications similaires des bras conduisent à un second type de protéines à teneur élevée en cystéine (Hc-B) à partir de la famille B des protéines du chorion. Il semble que l'évolution parallèle de ces familles de gènes codants pour des protéines à teneur élevée en cystéine ne soit pas complètement indépendante : l'examen des régions 3' non traduites met en évidence le transfert de l'information entre les deux familles.

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ICHIMURA S., MITA K., ZAMA M., NUMATA M.

Isolation of nuclei and nuclear proteins from the posterior silk gland of *Bombyx mori*. (Isolement des noyaux et des protéines nucléaires provenant de la partie postérieure de la glande séricigène de *Bombyx mori*.)

In Ultrastructure Funct. Insect Cells, Proc. Int. Conf., 1982, ed. by H. Akai, R.C. King, S. Morohoshi, publ. Bus. Center Acad. Soc. Japan, Tokyo, p. 37-40. (E)

IIZUKA T.

Detection and partial characterization by agarose gel electrophoresis of extrachromosomal DNA in germ cells, testes and ovaries of *Bombyx mori*. (Détection et caractérisation partielle par électrophorèse sur gel agarose de l'ADN extra-chromosomal dans les cellules germinales, les testicules et les ovaires de *Bombyx mori*.)

In: Ultrastructure Funct. Insect Cells, Proc. Int. Conf., 1982, ed. by H. Akai, R.C. King, S. Morohoshi, publ. Bus. Center Acad. Soc. Japan, Tokyo, p. 29-32. (E)

INOKUCHI T., YAMADA M., NAKAMURA K.

Effects of dietary conditions on urea contents in the pupa and adult hemolymphs and in the eggs of the silkworm *Bombyx mori*. (Effet des conditions alimentaires sur le contenu en urée dans l'hémolymphe de la chrysalide et de l'adulte et dans les oeufs du ver à soie *Bombyx mori*.)

Nippon Oyo Dobutsu, Konchu Gakkaishi, 1983, 27(2), p. 99-105. (J)

INOUE H.*, MITSUHASHI J.

A *Bombyx mori* cell line susceptible to a nuclear polyhedrosis virus. (Lignée cellulaire de *Bombyx mori* sensible au virus de la polyédrose nucléaire).

J. Sericult. Sci. Japan, 1984, 53(2), p. 108-113. (E,e) R

Embryonic cells from the "Kuroko" strain, a genetically well defined strain, of the silkworm, *Bombyx mori*, were cultured *in vitro*. In primary cultures, epithelial-like cells migrated and multiplied markedly. They contained large granules around their nuclei. This type of cells could be subcultured continuously, though their growth was comparatively slow. This cell line was found to be susceptible to *Bombyx mori* nuclear polyhedrosis virus.

Les cellules embryonnaires de la souche "Kuroko" du ver à soie *Bombyx mori*, souche bien définie du point de vue génétique, ont été cultivées *in vitro*. Dans les cultures primaires, les cellules de type épithélial migrent et se multiplient nettement. Elles contiennent de gros granules autour de leur noyaux. Ce type de cellules pourrait être repiqué en continu bien que leur croissance soit relativement faible. On a découvert que cette lignée cellulaire est sensible au virus de la polyédrose de *Bombyx mori*.

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KAI H., KAWAI T., KANETO A.

Esterase A4 elevation mechanism in relation to *Bombyx* egg diapause development. (Mécanisme d'élévation de l'estérase A4 liée au développement de la diapause de l'oeuf de *Bombyx mori*.)

App. Entomol. Zool., 1984, 19(1), p. 8-14. (E)

KATSUNO S.

Surface structure of the egg-shell in polyploid silkworm, *Bombyx mori*. (Structure de la surface du chorion chez le ver à soie polypléide *Bombyx mori*.)

J. Seric. Sci. Jpn., 1984, 53(2), p. 97-107. (E,e) R

The surface structure of the various areas of the egg-shell in triploid and tetraploid silkworms was observed under a differential interference microscope.

Triploid eggs: The size of the micropylar region was larger and its shape was more irregular than diploid eggs. The surface structure of the central part of the lateral region was principally the same as that of diploid eggs; namely, a unit of the network was enclosed within the projecting boundary and took the shape of a regular or irregular polygon, while small knobs formed the rest in the polygon. However, the size of the polygons was considerably larger and the number of knobs per polygon was much greater than in the diploid eggs. With regard to the respective surface structure of the area surrounding the micropylar region and of the central parts of the dorsal, abdominal and posterior regions, they differed again from the diploid eggs. Especially, the height of the various knobs or the height of the various walls resembling the boundaries in the lateral region was irregular, when the corresponding area was compared to the diploid eggs.

Tetraploid eggs: The surface structure of the central part of the lateral region was almost the same as in the triploid eggs, but compared with that of diploid eggs, a considerable difference was seen. However, with regard to the surface structure of other areas, there was no characteristic difference between tetraploid and diploid eggs.

La structure de la surface de diverses parties du chorion chez les vers à soie triploïdes et tétraploïdes est observée au microscope à interférence différentiel.

Oeufs triploïdes : La taille de la région micropylaire est plus grande et sa forme est moins régulière que celle des oeufs diploïdes. La structure de la surface du centre de la région latérale est à peu près la même que chez les oeufs diploïdes ; précisément, une unité du réseau est incluse et prend la forme d'un polygone régulier ou irrégulier, tandis que de petites protubérances forment le reste du polygone. Cependant, la taille des polygones est bien plus importante et le nombre de protubérances par polygone est bien plus grand que chez les oeufs diploïdes. La structure de surface de la partie environnant la région micropylaire et celle des parties centrales des régions dorsale, abdominale et postérieure, diffèrent des régions correspondantes chez les oeufs diploïdes. En particulier, la hauteur des diverses protubé-

rances ou la hauteur des divers murs ressemblant aux limites dans la région latérale, sont irrégulières lorsqu'on les compare à celles des régions correspondantes chez les oeufs diploïdes.

Oeufs tétraploïdes : La structure de la surface du centre de la région latérale est presque la même que celle des oeufs triploïdes, mais très différente de celle des oeufs diploïdes. Cependant, pour ce qui est de la surface des autres parties, il n'y a pas de différence notable entre les oeufs tétraploïdes et diploïdes.

KATSUNO S.

Size of facets of compound eye in the polyploid silkworm, *Bombyx mori*. (Taille des facettes de l'oeil composé du ver à soie polyploïde *Bombyx mori*).

J. Sericult. Sci. Japan, 1984, 53(3), p. 187. (E,e) R

The present study was undertaken to investigate the relationship among polyploids by the size of the facets of the compound eye. The size of the facets in the central part of the outer surface of the compound eye showed no difference between the male and female adults in tetraploid, triploid and diploid. The size of the facets in tetraploid adults was larger than those of triploid and diploid adults and the same tendency was seen in both male and female adults. The size of the facets in triploid adults was larger than those of diploid adults in females, while the size was either large or almost identical in males.

Cette étude a été effectuée pour déterminer les relations existant parmi les polyploïdes en se référant à la taille des facettes de l'oeil composé. La taille des facettes dans la partie centrale de la surface extérieure de l'oeil composé ne diffère pas entre les adultes mâles et femelles qu'ils soient tétraploïdes, triploïdes ou diploïdes. La taille des facettes est plus grande chez les adultes tétraploïdes que chez les adultes triploïdes et diploïdes et la même tendance apparaît à la fois chez les adultes mâles et femelles. La taille des facettes est plus grande chez les adultes femelles triploïdes que chez les adultes femelles diploïdes, elle est presque identique chez les mâles.

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KIGUCHI K., MORI T., AKAI H.

Effects of anti-juvenile hormone " ϵ TB" on the development and metamorphosis of the silkworm, *Bombyx mori*. (Effets de l'anti-hormone juvénile " ϵ TB" sur le développement et la métamorphose du ver à soie *Bombyx mori*.)

J. Insect Physiol., 1984, 30, p. 499. (E)

KIMURA K.

On a new multilunar marking mutation (L) appeared in the sex-limited yellow cocoon strain of the silkworm. (Nouvelle mutation de marquage multilunulaire (L) apparue chez la souche de ver à soie à cocon jaune.)

J. Seric. Sci. Jpn., 1984, 53(3), p. 253-254. (J) R

KONDO T., FUDAMI T., GOTO T., KAWAKAMI M., TAKEMURA S.

Determination of the structure and absolute configuration of a new modified nucleoside isolated from tRNA₂^{Gly} of *Bombyx mori* by a total synthesis to be a 5-(S-carboxy (hydroxy)methyl) uridine. (Détermination absolue de la structure et de la configuration d'un nouveau nucléoside modifié isolé à partir du tRNA₂^{Gly} de *Bombyx mori* par une synthèse totale pour devenir un 5-(S-carboxy(hydroxy)méthyl) uridine.)

Nucl. Ac. Symp. Ser., 1983, 12, p. 127-130. (E)

KRISHNAMURTHY N.B., RAMESH S.R., RAJASEKARASETTY M.R.

Developmental profiles in the isozymes of α and β esterases in the embryogenesis of silkworm *Bombyx mori*. (Profils de développement chez les isozymes des estérases α et β lors de l'embryogénèse chez le ver à soie *Bombyx mori*.)

Curr. Sci., 1984, 53(5), p. 281-284. (E)

LEGANIDOU R., EICKBUSH T.H., KAFATOS F.C.

Ribosomal DNA genes of *Bombyx mori*: a minor fraction of the repeating units contain insertions. (Gènes de l'ARN ribosomique de *Bombyx mori* : une fraction mineure des unités répétées contient des insertions.)

Nuc. Ac. Res., 1984, 12, p. 4703.

LIN CHANGQI

Studies on the correlation between the resistance to CPV and other economic characters of the silkworm. (Etudes sur la corrélation entre la résistance au virus de la polyédrose cytoplasmique et d'autres caractères économiques du ver à soie.)

Canye Kexue, 1984, 10(3), p. 158-162. (C) R

MA Y., CHEN W., WANG J., YAN X., et al.

Physico chemical properties and infectivity of the nuclear polyhedrosis virus of *Bombyx mori*. (Propriétés physico-chimiques et infectivité du virus de la polyédrose nucléaire de *Bombyx mori*.)

Wuhan Daxue Xuebao, Ziran Kexueban, 1983, 3, p. 96-105. (C)

MASUI H., MATSUBARA F.

Absorption, distribution and fate of cobalt in the germ free silkworm, *Bombyx mori*. (Absorption, distribution et rôle du cobalt chez le ver à soie *Bombyx mori* aseptique).

J. Sericult. Sci. Japan, 1984, 53(3), p. 222-225. (J,j,e) R

The amount of Co was measured distributing in tissues or organs of silkworms reared aseptically on an artificial feed or reared from hatching to the 6th day of the 5th instar on an artificial feed containing 50 ppm Co, and at the same time the amount of Co excreted into the feces and the amount transported into the pupa were determined. With silkworms reared on an artificial feed containing 36% mulberry leaf powder or those reared from hatching to the 6th day of the 5th instar on an artificial feed containing 50 ppm Co, the distribution of Co per 1 gram dry weight of tissue or organ and that per individual were calculated. When 50 ppm Co was administered continuously, the amount of Co excreted into the feces was increased immediately after being transferred to a Co-free feed, and decreased with time, mostly excreted in 48 hr. In the pupa obtained with the artificial diet alone, the Co amount was 3.14 g, but in the pupa obtained with a diet containing 50 ppm Co throughout the concentration of Co scarcely increased.

La quantité de Co a été mesurée dans les tissus ou les organes des vers à soie élevés d'une manière aseptique sur aliments artificiels ou élevés, de l'éclosion jusqu'au 6ème jour du 5ème âge, sur un aliment artificiel contenant 50 ppm de Co. Dans le même temps, nous avons déterminé la quantité de Co dans les matières fécales ainsi que la quantité transportée dans la nymphe. Nous avons calculé la distribution de Co par gramme de poids sec de tissu ou d'organe et par individu chez les vers à soie élevés sur un aliment artificiel contenant 36% de poudre de feuille de mûrier ou chez ceux qui sont élevés, de l'éclosion jusqu'au 6ème jour du 5ème âge, sur un aliment artificiel contenant 50 ppm de Co. Lorsque 50 ppm de Co sont administrés de manière continue, la quantité de Co excrétée dans les matières fécales augmente immédiatement après le transfert sur un aliment sans Co, puis diminue avec le temps, l'essentiel étant excrété en 48 h. Chez les nymphes obtenues avec un aliment artificiel, seule la quantité de Co s'élève à 3,14 g mais chez les nymphes obtenues avec une alimentation contenant 50 ppm de Co, la concentration de Co augmente faiblement.

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MATSUBARA F.*, WU Y.L.***, MORI H.***, OOGASHIRA H.*

Difference in susceptibility of germ free silkworm at each instar to NPV after cold treatment. (Différence de sensibilité au NPV après un traitement au froid du ver à soie sans germe à tous les âges larvaires).

J. Sericult. Sci. Japan, 1984, 53(3), p. 205-209. (J,j,e) R

Changes in the susceptibility of each instar larva of the silkworm, *Bombyx mori*, to NPV after cold treatment (5°C, 24 hr) were studied under an aseptic condition. Inoculum virus was nuclear polyhedrosis virus filtered through a 0.45µm millipore filter after the dissolution of nuclear polyhedra in alkali. Although newly hatched larvae were not sensitive to cold treatment, susceptibility to NPV after cold treatment increased with larval age from the 2nd to 5th instars. Infective NPV was detected in the haemolymph of the 5th instar larvae at 6hr after the oral administration with nuclear polyhedra following cold treatment.

Les différences de sensibilité au NPV du ver à soie *Bombyx mori* à chaque âge larvaire après traitement au froid ont été étudiées dans des conditions d'aseptie. Le virus inoculé est celui de la polyédrose nucléaire filtré sur millipore de 0,45µm après dissolution des polyèdres nucléaires dans l'alcali. Bien que les larves venant d'éclore ne soient pas sensibles au traitement au froid, la sensibilité au NPV augmente après ce traitement chez les larves du 2ème au 5ème âge. L'infection au NPV a été détectée dans l'hémolymphe des larves du 5ème âge traitées au froid six heures après l'administration par voie orale de polyèdres nucléaires.

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** *Suzhou Sericultural College, Jiangshu, China.*

*** *Faculty of Agriculture, Nagoya University, Nagoya 464, Japan.*

MIHAESCU A., STANCIU N., ADLER A.

Studies on the variation of some physiological and biochemical parameters of silkworms with/without diapause. (Etudes des variations de certains paramètres physiologiques et biochimiques des vers à soie diapausants ou non diapausants.)

An. Univ. Bucuresti. Biol., 32, p. 63-66. (F)

MORISHIMA I.

Calmodulin stimulation of adenylate cyclase in fat body of the silkworm, *Bombyx mori*. (Stimulation par la calmoduline de l'adénylate cyclase dans le corps gras du ver à soie *Bombyx mori*.)

Insect Biochem., 1984, 14(5), p. 491-494. (E,e) R

The effects of Ca^{2+} and calmodulin on the adenylate cyclase activity in a particulate fraction from silkworm fat body was examined. Calmodulin from fat body which lacks trimethyllysine stimulates fat body adenylate cyclase similarly to porcine brain calmodulin both in the presence of low concentrations of Ca^{2+} . The concentration of both calmodulins for half-maximal stimulation of the enzyme is 80nM. The calmodulin-stimulated activity is suppressed by trifluoperazine ($\text{I}_{50} = 120\mu\text{M}$). GTP and its hydrolysis-resistant analogue 5'-guanylyl imidodiphosphate have no significant effect on basal or calmodulin-stimulated adenylate cyclase activity.

Les effets du Ca^{2+} et de la calmoduline sur l'activité de l'adénylate cyclase sont étudiés sur une fraction particulaire du corps gras de ver à soie. La calmoduline du corps gras qui ne contient pas de triméthyllysine, stimule l'adénylate cyclase du corps gras, de la même manière que la calmoduline du cerveau de porc en présence de faibles concentrations de Ca^{2+} . La concentration entraînant une stimulation demi-maximale de l'enzyme est de 80nM pour les deux calmodulines. L'activité stimulée par la calmoduline est supprimée par la trifluopérazine ($\text{I}_{50} = 120\mu\text{M}$). Le GTP et son analogue résistant à l'hydrolyse, le 5'-guanylyl imidodiphosphate, n'ont pas d'effet important ni sur l'activité ordinaire de l'adénylate cyclase, ni sur l'activité stimulée par la calmoduline.

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MOROHOSHI S.

Control in *Bombyx mori* of the hormonal antagonistic balance regulating development by the brain hormone. (Contrôle par l'hormone du cerveau de l'équilibre hormonal antagoniste régissant le développement chez *Bombyx mori*.)

In: Ultrastructure Funct. Insect Cells, Proc. Int. Conf., 1982, ed. by H. Akai, R.C. King, S. Morohoshi, publ. Bus. Center Acad. Soc. Japan, Tokyo, p. 109-112. (E)

OHNISHI E.

Endocrine mechanisms underlying sequential changes in behaviour during insect metamorphosis. (Mécanismes endocriniens entraînant des changements séquentiels dans le comportement pendant la métamorphose de l'insecte.)

Animal Behaviour, 1984, p. 201-209. (E)

SAKURAI S.

Temporal organization of endocrine events underlying larval-pupal metamorphosis in the silkworm *Bombyx mori*. (Organisation temporelle des événements endocriniens entraînant la métamorphose de la larve en chrysalide chez le ver à soie *Bombyx mori*.)

J. Insect Physiol., 1984, 30, p. 657.

SHYLAJA M.S., RAMAIAH T.R.

Isoenzymes of glutamate-oxalacetate transaminase in the larvae of silkworms *Bombyx mori* infected with nuclear polyhedrosis virus. (Isoenzymes de la glutamate-oxalacétate transaminase chez les larves de ver à soie *Bombyx mori* infectées par le virus de la polyédrose nucléaire.)

Experientia, 1984, 40, p. 717.

SONOBE H., OKADA Y.

Studies on the embryonic diapause of the pnd mutant of the silkworm *Bombyx mori*. 3) Accumulation of alanine in the diapause eggs. (Etudes sur la diapause embryonnaire du mutant pnd du ver à soie *Bombyx mori*. 3) Accumulation d'alanine dans les oeufs en diapause.)

W. Roux's Archives of Dev. Biol., 1984, 193, p. 414.

SUZUKI K., HOSAKA M., MIYA K.

The amino acid pool of *Bombyx mori* eggs during diapause. (Le pool d'acides aminés des oeufs de *Bombyx mori* pendant la diapause.)

Insect Biochem., 1984, 14(5), p. 557-561. (E,e) R

The levels of alanine and glutamine in the amino acid pool of *Bombyx mori* eggs changed significantly after oviposition. In diapause eggs the alanine content increased by about 8-fold between 24 and 48 hr after oviposition to reach 42.7 $\mu\text{mol/g}$. In non-diapause eggs, however, alanine levels remained constant over a similar period. In contrast the glutamine content remained constant at less than 0.5 $\mu\text{mol/g}$ in diapause eggs but increased progressively in non-diapause eggs. At the end of diapause, the alanine content decreased and the glutamine content approached the same level as in non-diapause eggs. At the end of diapause, the alanine content decreased and the glutamine content approached the same level as in non-diapause eggs. The glutamate level did not change at the initiation or termination of diapause, but the proline content increased markedly at the latter time. These results suggest that alanine accumulation at the initiation of diapause might serve a protective function similar to that of polyols. *De novo* alanine synthesis may require protein breakdown to provide the needed amino groups; at the termination of diapause, however, alanine might be converted to proline.

Les niveaux d'alanine et de glutamine dans le pool d'acides aminés des oeufs de *Bombyx mori* varient de manière significative après la ponte. Chez les oeufs diapausants, le contenu en alanine se multiplie par 8 entre la 24ème et la 48ème heure après la ponte pour atteindre 42,7 $\mu\text{mol/g}$. Chez les oeufs non-diapausants, la teneur en alanine reste constante au cours de la même période. Au contraire, le contenu en glutamine reste constant à moins de 0,5 $\mu\text{mol/g}$ chez les oeufs diapausants mais augmente progressivement chez les oeufs non-diapausants. A la fin de la diapause, le contenu en alanine diminue et le contenu en glutamine tend à être identique à celui observé chez les oeufs non-diapausants. Le contenu en glutamate ne varie pas au début ni à la fin de la diapause, mais le contenu en proline augmente de façon marquée à la fin de la diapause. Ces résultats suggèrent que l'accumulation d'alanine au début de la diapause pourrait avoir une fonction protectrice semblable à celle des polyols. La synthèse *de novo* d'alanine pourrait nécessiter la dégradation des protéines pour fournir les groupes aminés nécessaires ; à la fin de la diapause cependant, l'alanine pourrait être convertie en proline.

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SUZUKI Y., ADACHI S.

Signal sequences associated with fibroin gene expression are identical in fibroin-producer and -nonproducer tissues. (Les séquences-signal associées à l'expression du gène de la fibroïne sont identiques dans les tissus producteurs de fibroïne et dans les tissus non-producteurs)

Develop. Growth and Differ., 1984, 26(2), p. 139-147. (E,e) R

DNA sequencing has been carried out for the region of nucleotide position -649 to +1261 of the fibroin DNA originally cloned from *Bombyx mori* pupae in which the fibroin gene is not expressed (nonproducer tissues). This sequence was compared with that from the posterior silk gland cells, where the gene is expressed (producer tissue), of a different strain. Both sequences are identical in the regions of -297 to +333 and +746 to +1261, leaving some base changes in the remaining regions. The regions of the identical sequences contain important signals for the fibroin gene expression: -29 to +6 for promoter function, -238 to -116 and -73 to -53 for signals for transcription enhancement, and around +66 and +1037 for the exon/intron boundaries. Template activities of the fibroin DNAs from the producer and the nonproducer were indistinguishable when assayed in a cell-free transcription system prepared from the silk glands. The result suggests that the base changes found in the regions of -649 to -298 and +334 to +745 of the fibroin DNAs from two strains are neutral mutations that do not affect the transcription activities of the genes. Thus, DNA rearrangements or somatic mutations are not likely to contribute to the tissue-specific expression of the fibroin gene.

L'établissement des séquences d'ADN est effectué pour la région comprise entre le nucléotide -649 et le nucléotide +1261 de l'ADN de fibroïne cloné à partir de chrysalides de *Bombyx mori* chez lesquelles le gène de la fibroïne n'est pas exprimé (tissus non-producteurs). Cette séquence est comparée avec celle des cellules de la partie postérieure de la glande séricigène d'individus d'une souche différente, où le gène est exprimé (tissus producteurs). Ces deux séquences sont identiques dans les régions de -297 à +333 et +746 à +1261, quelques changements intervenant dans les autres régions. Les régions de séquences identiques contiennent des signaux importants pour l'expression du gène de la fibroïne ; -29 à +6 pour la fonction de promoteur, -238 à -116 et -73 à -53 pour les signaux renforçant la transcription, et environ +66 et +1037 pour les limites exon/intron. Les activités "matrice" des ADNs de fibroïne provenant des producteurs ou des non-producteurs ne peuvent être distinguées dans un système acellulaire de transcription préparé à partir des glandes séricigènes. Le résultat suggère que les changements de bases trouvés dans les régions de -649 à -298 et de +334 à +745 des ADNs de fibroïne de deux souches différentes sont des mutations neutres qui n'affectent pas les activités de transcription des gènes. Ainsi, des réarrangements de l'ADN ou des mutations somatiques ne sont pas susceptibles de contribuer à l'expression tissulaire spécifique du gène de la fibroïne.

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TAKEI F., KIMURA K., MIZUNO S., YAMAMOTO T., SHIMURA K.

Genetic analysis of the Nd.s mutation in the silkworm *Bombyx mori*. (Analyse génétique de la mutation Nd.s chez le ver à soie *Bombyx mori*.)

Jap. J. Genetics, 1984, 59, p. 307.

TAMURA T., SAKATE S.

Relation between the expression of oily character and uric acid incorporation in the larval integument of various oily mutants of the silkworm *Bombyx mori*. (Relation entre l'expression du caractère huileux et l'incorporation d'acide urique dans le tégument larvaire de différents mutants huileux du ver à soie *Bombyx mori*.)

Sanshi Shikenjo Hokoku, 1983, 28(6), p. 719-740. (J)

TASHIRO Y., MATSUURA S., SASAKI S.

Role of the cytoskeletal systems in the biosynthesis, intracellular transport and secretion of fibroin in the posterior silk gland cells of *Bombyx mori*. (Rôle du cytosquelette dans la biosynthèse, le transport intracellulaire et la sécrétion de fibroïne dans les cellules de la partie postérieure de la glande séricigène de *Bombyx mori*.)

In: Ultrastructure Funct. Insect Cells, Proc. Int. Conf., 1982, ed. by H. Akai, R.C. King, S. Morohoshi, publ. Bus. Center Acad. Soc. Japan, Tokyo, p. 149-152. (E)

TAZIMA Y., KOBAYASHI Y., OZAWA T., MACHIDA I.

Studies on an induction and inheritance of non preference mutation (Np) in the silkworm. (Etude d'une induction et de l'héritabilité de la mutation "sans préférence" (Np) chez le ver à soie.)

Reports of the Silk Sci. Res. Inst., 1984, 32, p. 7-30. (J,j,e) R

TSUJIMOTO Y., SUZUKI Y.

Natural fibroin genes purified without using cloning procedures from fibroin-producing and -non-producing tissues reveal indistinguishable structure and function. (Les gènes naturels de fibroïne purifiés à partir de tissus producteurs et non-producteurs de fibroïne, sans employer des procédés de clonage, ont des structures et des fonctions indistinguables.)

Proc. Natl. Acad. Sci. USA, 1984, 81, p. 1644-1648. (E,e) R

Natural fibroin genes were purified from total DNA extracted from the fibroin-producer cells (posterior silk gland) and -non-producer cells (middle silk gland or pupa) by two cycles of CsCl/actinomycin D centrifugation followed by sucrose density gradient centrifugation. Purity of the final samples was 14%. DNA sequences of these natural genes between positions -171 and +104 were identical and showed no sign of base modification as assayed by the method of Maxam and Gilbert. The determined sequence includes the promoter and a major part of the modulator. When assayed in an *in vitro* transcription system prepared from middle silk gland, template activities of the purified natural fibroin genes from the producer and the nonproducer were indistinguishable from that of cloned fibroin DNA. Digestion and blotting of total genomic DNAs with several restriction enzymes that recognize methylation changes on DNA revealed no difference of hybridization pattern of fibroin DNAs in a region from -650 to +326 between the producer and nonproducer. Thus, it is unlikely that the differential transcription of the fibroin gene is controlled by a change of base modification in the regions of transcription signals.

Les gènes naturels de fibroïne sont purifiés à partir de l'ADN total extrait de cellules productrices de fibroïne (partie postérieure de la glande séricigène) et de cellules non-productrices de fibroïne (partie médiane de la glande séricigène ou chrysalide) par deux cycles de centrifugation en CsCl/actinomycine D suivis d'une centrifugation sur gradient de sucrose. La pureté finale des échantillons est supé-

rieure à 14 %. Les séquences de ces gènes naturels entre les positions -171 et +104 sont identiques et ne montrent aucun signe de modification de bases par la méthode de Maxam et Gilbert. La séquence déterminée inclut le promoteur et une grande partie du modulateur. Dans un système de transcription *in vitro* préparé à partir de la partie médiane de la glande séricigène, les activités de "modèle" des gènes naturels de fibroïne purifiés (provenant des tissus producteurs et non-producteurs) ne sont pas différenciables de celles de l'ADN de fibroïne cloné. La digestion des ADN génomiques totaux par plusieurs enzymes de restriction qui reconnaissent les changements dus à la méthylation sur l'ADN, ne révèlent aucune différence du profil d'hybridation dans la région située entre -650 et +326, entre les ADN des tissus producteurs et non-producteurs. Il est donc peu probable que la transcription différentielle du gène de la fibroïne soit contrôlée par une variation des bases modifiées dans les régions des signaux de transcription.

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UEDA H., HYODO A., TAKEI F., SASAKI H., OSHIMA Y., SHIMURA K.

Sequence polymorphisms in the 5'-upstream region of the fibroin H-chain gene in the silkworm, *Bombyx mori*. (Polymorphismes des séquences dans la région 5' en amont du gène de la chaîne H de la fibroïne chez le ver à soie *Bombyx mori*.)

Gene, 1984, 28, p. 241-248. (E,e) R

DNA fragments containing the fibroin H-chain gene from two different strains of *Bombyx mori*, J-139 and Nd(2) were cloned into phage λ Charon 4A. Comparison of the restriction sites in these cloned DNAs revealed that in addition to the known polymorphism in the region coding for the repetitive amino acid sequence of the fibroin H-chain (Manning and Gage, J. Biol. Chem., 255 (1980) 9451-9457), at least two other types of polymorphism were present, one around the 5' end of the structural gene, and the other in the far upstream region of the gene.

Restriction sites around the 5' end of the gene were well conserved between these strains, but some heterogeneity, suggesting the presence of small insertions, deletions or base changes, was noted.

In contrast, DNA sequences of the region 2-4kb upstream from the 5' end of the gene were markedly different between these two strains, indicating that either a deletion or an insertion of a DNA sequence longer than 2kb had occurred in this region. Comparison with several other strains suggested that the observed changes in the far upstream region were unique to the Nd(2) strain.

Des fragments d'ADN contenant le gène de la chaîne H de la fibroïne provenant de deux souches différentes de *Bombyx mori*, J-139 et Nd(2), ont été clonés dans le phage λ Charon 4A. La comparaison des sites de restriction dans ces ADN clonés révèle que, en plus du polymorphisme connu dans la région codant pour la séquence répétitive des acides aminés de la chaîne H de la fibroïne (Manning et Gage, J. Biol. Chem. 255 (1980) 9451-9457), au moins deux autres types de polymorphisme sont présents, l'un autour de l'extrémité 5' du gène structural, et l'autre dans la région très en amont du gène.

Les sites de restriction autour de l'extrémité 5' du gène sont bien conservés entre ces souches, mais une certaine hétérogénéité suggère la présence de petites insertions, délétions ou changements de base.

Au contraire, les séquences d'ADN de la région 2-4kb en amont de l'extrémité 5' du gène sont assez différentes entre ces souches, indiquant qu'une délétion ou

une insertion d'une séquence d'ADN plus longue que 2kb est survenue dans cette région. La comparaison avec plusieurs autres souches suggère que les changements observés dans la région loin en amont sont spécifiques à la souche Nd(2).

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WAGO H.

In vitro evidence for the requirement of filopodial elongation for the progress of phagocytosis by phagocytic granular cells of the silkworm *Bombyx mori*. (Démonstration *in vitro* de la nécessité d'une élongation filopodiale dans le processus de phagocytose pour les cellules granuleuses phagocytaires du ver à soie *Bombyx mori*.)

Develop. & Com. Immunol., 1984, 8, p. 7.

WASHIDA S.

Influence of juvenile hormone analogues applied at fourth instar on larval growth and cocoon weight in *Bombyx mori*. (Influence des analogues d'hormone juvénile administrés au 4^{ème} âge sur la croissance larvaire et le poids du cocon de *Bombyx mori*).

J. Sericult. Sci. Japan, 1984, 53(3), p. 210-215. (j,j,e) R

A juvenile hormone analogue (methoprene, JHA) was topically applied to the fourth instar larvae of the silkworm, *Bombyx mori*, and larval growth, pupation and cocoon weight were examined. Application of JHA (10 µg/larva) at 36, 48, and 60 hrs after third larval ecdysis delayed somewhat the fourth larval ecdysis and elongated markedly the duration of fifth larval instar. The effect of elongation of the last larval instar was more prominent when applied in earlier stages of fourth larval instar, and, as a result, cocoon weight as well as body weight of mature larvae were increased. These larvae exhibited several grades of larval-pupal intermediates. Duration of the last instar, larval weight, cocoon weight and abnormal pupation were dependent on dosages of JHA applied. JHA at a dosage of 25 µg/larva caused 4-day delay of larval maturation and about 26 percent increase in cocoon weight, while larvae grew almost normally at a dosage of 1 µg/larva. The effects of topical application of JHA in fourth instar are almost comparable with those of JHA application at the critical stages of the fifth instar, suggesting a possibility that larval growth and cocoon weight could practically be controlled by applying in the fourth instar.

Un analogue de l'hormone juvénile (méthoprène, JHA) a été administré de manière topique aux larves de ver à soie *Bombyx mori* du 4^{ème} âge et nous avons étudié la croissance larvaire, la nymphose et le poids du cocon. L'administration du JHA (10 µg/larve) 36, 48 et 60 heures après la troisième mue larvaire retarde la quatrième mue larvaire et prolonge nettement la durée du cinquième âge. L'effet de la prolongation du dernier âge larvaire est plus important lorsque le JHA est administré au tout début du quatrième âge et il en découle une augmentation du poids du cocon et du corps de la larve mature. Ces larves montrent plusieurs stades intermédiaires larve-nymphé. La durée du dernier âge larvaire, le poids de la larve, le poids du cocon et la nymphose anormale dépendent des doses de JHA administrées. Une dose de JHA à 25 µg/larve provoque un retard de 4 jours de la maturation larvaire et une augmentation d'environ 26 % du poids du cocon, alors que les larves ont une croissance presque normale avec une dose de 1 µg/larve. Les effets de l'administration topique de JHA au 4^{ème} âge sont presque comparables à ceux de l'administration de JHA aux stades critiques du 5^{ème} âge. Ceci suggère que la croissance larvaire et le poids du cocon pourraient être pratiquement contrôlés par l'administration de JHA au 4^{ème} âge.

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XIAO C., XIE X., LIU X., ZHANG Q., XIAN W.

Preliminary report on the isolation and analysis of free aminoacids from silkworm feces. (Rapport préliminaire sur l'isolement et l'analyse des acides aminés libres provenant des fécès de ver à soie.)

Zhongyao Tongbao, 1984, 9(1), p. 29-30. (C)

YAMAUCHI H., YOSHITAKE N.

Developmental stages of ovarian follicles of the silkworm, *Bombyx mori* L. (Stades du développement des follicules ovariens chez le ver à soie *Bombyx mori* L.)

Journal of Morphology, 1984, 179, p. 21-31. (E,e) R

Oogenesis in the silkworm, *Bombyx mori*, was studied by light and electron microscopy of sections of resin-embedded follicles. The development of the follicles was divided into a series of 12 distinctive stages based on various morphological criteria. Structural changes in the oocyte, nurse cells, and follicle cells are described and illustrated.

L'ovogenèse chez le ver à soie *Bombyx mori* est étudiée par microscopie optique et électronique des coupes de follicules enrobés de résine. Le développement des follicules se décompose en 12 stades distincts basés sur divers critères morphologiques. Nous avons décrit et illustré les changements de structure dans les ovocytes, les cellules nourricières et les cellules folliculaires.

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YAMAUCHI H., YOSHITAKE N.

Formation and ultrastructure of the micropylar apparatus in *Bombyx mori* ovarian follicles. (Formation et ultrastructure de l'appareil micropylaire dans les follicules ovariens de *Bombyx mori*.)

Journal of Morphology, 1984, 179, p. 47-58. (E,e) R

The formation of the micropylar apparatus during oogenesis in the silkworm, *Bombyx mori*, has been studied using light and transmission electron microscopy. The micropylar apparatus is formed by three types of cells: the micropylar channel-forming cells (MCFCs), the micropylar orifice-forming cells (MOFCs), and the micropylar rosette-forming cells (MRFCs). During the formation of the vitelline membrane and the chorion, each of the MCFCs extends a cytoplasmic projection serving as the mold of a micropylar-channel into the egg envelopes. The detachment and collapse of the projections takes place at the end of choriogenesis. The micropylar channels possess a common external orifice on the chorion and several internal orifices within the vitelline membrane. The MOFCs interact closely with the MCFCs and contribute to the formation of the external micropylar orifice. A petal-like rosette surrounding the orifice is imprinted on the outer chorionic surface by the MRFCs which enclose a group of the MCFCs and MOFCs.

Nous avons étudié la formation de l'appareil micropylaire chez le ver à soie *Bombyx mori* pendant l'ovogenèse, par microscopie optique et électronique. L'appareil micropylaire se compose de 3 types de cellules : les cellules formant le canal du micropyle (MCFCs), les cellules formant l'orifice du micropyle (MOFCs) et les cellules formant la rosette du micropyle. Pendant la formation de la membrane vitelline et du chorion, chacune des MCFCs étend une projection cytoplasmique servant de matrice au canal micropylaire à l'intérieur des enveloppes de l'oeuf. Le détachement

et l'affaissement des projections intervient à la fin de la choriogenèse. Les canaux micropylaires possèdent un orifice externe commun sur le chorion et plusieurs orifices internes dans la membrane vitelline. Les cellules MOFCs ont une interaction très étroite avec les cellules MCFC et contribuent à la formation de l'orifice externe du micropyle. Une rosette en forme de pétale entourant l'orifice est imprimée sur la paroi externe du chorion par les cellules MRFCs qui comprennent un groupe de cellules MCFCs et MOFCs.

YING B., MORISAKI M., IKEKAWA N.

Oxygenated sterol derivatives: their identification from the fungus-infected silkworm carcass, *Bombyx* cum *Botryte* and their effects on growth and sterol metabolism of the silkworm *Bombyx mori*. (Dérivés de stérol oxygénés : leur identification à partir de cadavres de vers à soie *Bombyx* infectés par le champignon *Botryte*, et leurs effets sur la croissance et le métabolisme des stérols du ver à soie *Bombyx mori*.)

Chem. Pharm. Bull., Tokyo, 1984, 32, p. 3603.

ZHU FANGRONG

Studies on the heritability of some quantitative characters in the silkworm (*Bombyx mori*) and the genetic correlation between these characters. (Etudes sur l'hérédité de quelques caractères quantitatifs chez le ver à soie *Bombyx mori* et corrélation génétique entre ces caractères.)

Ganyu Kexue, 1984, 10(3), p. 145-149. (C) R

ZHUANG DAHUAN, et al.

Bio-active efficiency of insect juvenile hormone analogues and phylogenous molting hormones in different developmental stages in the silkworm. (Efficacité bio-active des analogues de l'hormone juvénile des insectes et des hormones de mue phylogènes pour les différents stades du développement chez le ver à soie.)

Ganyu Kexue, 1984, 10(3), p. 138-144. (C) R

SERICIGENES NON-MURIER / NON-MULBERRY SILKWORMS

FAYARD J.M., DEBOUZIE D.

Variation du nombre des cellules séricigènes entre diverses souches de *Galleria mellonella*. (Variation in silk gland cell number between wild and laboratory strains of *Galleria mellonella*.)

Archives d'Anatomie microscopique, 1984, 73(1), p. 9-13. (F,f,e) R

La variabilité du nombre des cellules des glandes séricigènes est mesurée chez la fausse teigne des ruches *Galleria mellonella*. Les différences entre 12 souches naturelles restent faibles, bien que significatives : de 183 à 211 cellules en moyenne pour l'ensemble sécréteur et réservoir de chaque glande. En revanche, les deux souches de laboratoire étudiées (valeur moyenne : 185 cellules) se distinguent nettement des souches précédentes (moyenne générale : 199 cellules).

La symétrie des glandes droite et gauche, la corrélation positive entre les nombres de cellules du sécréteur et du réservoir, et la constance, sur deux générations, du classement des souches selon leurs nombres de cellules, plaident en faveur d'un déterminisme génétique important au niveau de l'espèce.

Variation in the number of cells of silk glands is measured on the greater wax moth *Galleria mellonella*. The differences between 12 natural strains remain small but significant : from 183 to 211 cells on the average for the two secretory parts of each gland. On the other hand, the two laboratory strains (185 cells on the average) differ from the previous strains (great mean : 199 cells).

The symmetry of right and left glands, the positive correlation between the cell number of the reservoir and of the secretory tube, and the constancy during two successive generations in the ranking of the strains according to their mean number of cells, give arguments for a strong genetic determinism at the species level.

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LIU Tingyin

Studies on hibernation of eri silkworm (*Philosamia cynthia ricini*). Induction of hibernation condition in multivoltine eri silkworm. (Etudes sur l'hibernation du ver à soie *Philosamia cynthia ricini*. Induction de l'hibernation chez le ver à soie eri multivoltin.)

Scientia Sinica, 1982, 25(1), p. 46-54. (E,e) R

Philosamia cynthia ricini belongs to the non-hibernating multivoltine insects. Our research has found ways and methods to make it undergo hibernation. By letting the larvae pass through "deep autumn-like" conditions and allowing the pupae to undergo "winter-like" conditions through 3 successive generations, we have succeeded in selecting a new strain of *P. cynthia ricini* which can hibernate in the forms of pupae in North China. The original strain is a subtropical, multivoltine and non-hibernating form. This has laid the foundation of raising and rearing self-perpetuation *P. cynthia ricini* both inside and outside the Great Wall. At the same time, it may also pave the way for artificial induction of hibernation in non-hibernating multivoltine insects.

Philosamia cynthia ricini appartient à la famille des insectes multivoltins non-hibernants. Nos recherches nous ont permis de trouver une méthode pour les faire hiberner. En laissant les larves subir des conditions identiques à celles de l'automne, puis à celles de l'hiver, pendant 3 générations successives, nous avons réussi à sélectionner une nouvelle souche de *P. cynthia ricini* qui peut hiberner comme les chrysalides du nord de la Chine. La souche originelle est une souche subtropicale, multivoltine et non hibernante. Ceci a permis l'élevage de *P. cynthia ricini* aussi bien à l'intérieur qu'à l'extérieur de la Grande Muraille. Cela pourrait permettre également d'induire l'hibernation artificiellement chez les insectes multivoltins non hibernants.

LIU Tingyin

Studies on hibernation of eri silkworm (*Philosamia cynthia ricini*). Rules of appearance of hibernation in cultivated eri silkworm. (Etudes sur l'hibernation du ver à soie eri (*Philosamia cynthia ricini*). Règles de l'apparition de l'hibernation chez les vers à soie eri domestiqués.)

Scientia Agricultura Sinica, 1984, 1, p. 87-95. (C,e) R

The environmental factors (such as temperature, photoperiod and humidity) which play an important part in each developing stage of eri silkworm (egg, 1st-5th instar larva, prepupa and early pupa) and the relationship between the environment and the hibernation of pupa are discussed in this article. 1) The low temperature ($17 \pm 1^\circ\text{C}$) during 5th larval instar, prepupal and early pupal stages is the key to obtaining hibernation. The upper limit, the lower limit and the optimum range of the temperature at which the pupae could hibernate, are given. 2) The short photoperiod (10 ± 2 hours) during the 4th and 5th larval instar is also an essential condition to hibernation. The influence of photoperiod, illumination and colour rays in different wavelengths upon hibernation is discussed. 3) It is beneficial to hibernation that egg, 1st, 2nd, and 3rd instar larva, at the temperature of $25 \pm 2^\circ\text{C}$, are raised under 12 hours' photoperiod. 4) As far as the humidity is concerned, if the humidity during 4th and 5th larval instar is a little bit lower, it will be beneficial to hibernation. 5) As to food, the feeding of eri silkworm with fully grown leaves of castor plant (*Ricinus communis*) could increase the hibernating rate more than with young leaves. However, feeding the eri silkworm with leaves of *Ailanthus occidentalis* could increase the hibernating rate even more obviously than with leaves of castor plant.

Les facteurs de l'environnement tels que la température, la photopériode et l'humidité, qui jouent un rôle important dans chaque stade du développement du ver à soie eri (oeuf, 1er-5ème âge larvaire, pré-nymphé et nymphe) et la relation entre l'environnement et l'hibernation de la nymphe sont étudiés dans cet article. 1) Une basse température ($17 \pm 1^\circ\text{C}$) pendant le 5ème âge larvaire, et les stades de pré-nymphose et nymphose est la clé pour obtenir l'hibernation. Les températures minimales

et maximales qui permettent aux nymphes d'hiberner sont données dans cet article. 2) La brève photopériode (10 ± 2 heures) au cours du 4ème et du 5ème âge larvaire est également une condition essentielle à l'hibernation. L'influence de la photopériode, de l'illumination et de la couleur du rayonnement à différentes longueurs d'ondes sur l'hibernation est étudiée. 3) Il est préférable pour l'hibernation que les oeufs et les larves des 1er, 2ème et 3ème âges soient élevées à une température de $25 \pm 2^\circ \text{C}$ avec une photopériode de 12 heures. 4) En ce qui concerne l'humidité, il est préférable pour l'hibernation que l'humidité soit plus faible pendant les 4ème et 5ème âges larvaires. 5) Quant à la nourriture, l'alimentation du ver à soie eri avec des feuilles de ricin (*Ricinus communis*) ayant achevé leur croissance, pourrait augmenter le taux d'hibernation comparativement à l'alimentation avec des feuilles jeunes. Cependant, le taux d'hibernation pourrait augmenter de manière plus sensible avec des feuilles d'*Atlantus occidentalis*.

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MICHALIK J., SEHNAL F., LASSOTA Z.

Synthesis of RNA and silk protein in *Galleria mellonella* silk glands. (Synthèse de l'ARN et des protéines de la soie dans la glande séricigène de *Galleria mellonella*.)

Acta Biochimica Polonica, 31, p. 139.

RAMAKRISHNAN V.

Hormonal regulation of blood protein metabolism in the last instar larva of eri silk-worm *Philosamia cynthia*. (Régulation hormonale du métabolisme des protéines de l'hémolymphe chez la larve du cinquième âge du ver à soie eri *Philosamia cynthia*.)

Proc. Symp. Cell. Control., Mech., 1982, p. 386-390. (E)

SEMEANOVA M.N., TURPAEV T.M.

Activity and substrate inhibitory properties of cholinesterases from developing embryos of various animals. (Activité et propriétés d'inhibition de substrat des cholinestérases provenant d'embryons en développement de divers animaux.)

Zh. Evol. Biokhim. Fiziol., 1983, 19(4), p. 414-419. (R)

TAMURA T., AKAI H., SAKATE S.

Ultrastructure of the silk glands and isolation of the fibroin mRNAs from *Antheraea yamamai* and other non-mulberry silkworms. (Ultrastructure des glandes séricigènes et isolement des mRNAs de fibroïne provenant de *Antheraea yamamai* et d'autres vers à soie non-mûriers.)

In: Ultrastructure Funct. Insect Cells, Proc. Int. Conf., 1982, ed. by H. Akai, R.C. King, S. Morohoshi, publ. by Bus. Center Acad. Soc. Japan, Tokyo, p. 139-142. (E)

WISNIEWSKI J.R., KOCHMAN M.

Juvenile-hormone-binding protein from silk gland of *Galleria mellonella*. (Protéine fixatrice de l'hormone juvénile provenant de la glande séricigène de *Galleria mellonella*.)

Febs Letters, 1984, 171, p. 127. (E)

XU Q., et al.

The morphological change of the silk gland of Chinese tussah silkworm (*Antheraea pernyi* G.M.) during metamorphosis. (Changement morphologique de la glande séricigène du ver à soie tussah chinois (*Antheraea pernyi* G.M.) au cours de la métamorphose.)

Canye Kexue, 1984, 10(2), p. 94. (C) R

XU W., et al.

Experiments on infection of larvae of *Antheraea pernyi*, *Bombyx mori* and *Spilarctia japonensis* by the nuclear polyhedrosis virus of *Hyphantria cunea*. (Expériences sur l'infection de larves de *Antheraea pernyi*, *Bombyx mori* et *Spilarctia japonensis* par le virus de la polyédrose nucléaire de *Hyphantria cunea*.)

Canye Kexue, 1984, 10(1), p. 38. (C) R

ZHOU HUAIMIN, et al.

Studies on the resistance of the larvae of *Antheraea pernyi* to Per Oral infection with NPV. (Etudes sur la résistance des larves de *Antheraea pernyi* à l'infection par voie orale avec le virus de la polyédrose nucléaire.)

Canye Kexue, 1984, 10(3), p. 178-181. (C) R

SOIE / SILK

ASAKURA T., WATANABE Y., UCHIDA A., MINACAWA H.

NMR of silk fibroin. Carbon 13 NMR study of the chain dynamic and solution structure of *Bombyx mori* silk fibroin. (NMR de la fibroïne. Etude par NMR au carbone 13 de la dynamique moléculaire et de la structure en solution de la fibroïne de *Bombyx mori*).

Macromolecules, 1984, 17(5), p. 1075. (E)

CALVERT P.

Silken spider chains. (Chaînes soyeuses d'araignées séricigènes).

Nature, 1984, 309, p. 516. (E) R

CHEN M., et al.

Studies on the dissolving nature of sericin in cocoon layer spun by Chinese tussah silkworm. (Etude de la nature dissolvante de la sérécine chez les cocons filés par les vers à soie tussah de Chine).

Canye Kexue, 1984, 10(1), p. 42. (C) R

CIENIEWSKA M.

Use of starved silkworm pupae as a raw material for the production of chitosan and chitin used in the production of non-woven fabrics. (Utilisation de la chrysalide de ver à soie comme matière première pour la production de chitosane et chitine employées dans la fabrication de tissus non-tissés).

Tech. Wlok., 1983, 32(4), p. 105-106. (P1)

FREITAG R.

Raw silk and its tenacity. (La soie grège et sa ténacité).

I.S.A. Congress, Venice, 1984. (E) R

GAMO T.*, HIRABAYASHI T.

Genetic analysis of the boiling off ratio in cocoon shell by diallel crosses in the silkworm, *Bombyx mori* L. (Analyse génétique du taux de décreusage de la coque soyeuse au moyen de croisements dialléliques chez le ver à soie *Bombyx mori* L.)

J. Seric. Sci. Jpn., 1984, 53(2), p. 114-120. (J,j,e) R

Genetic analysis was carried out on the boiling off ratio (BOR) in cocoon shell of the silkworm by diallel crosses of eight improved strains. As a result of estimation of the genetic parameters and of the regression analysis of W_r (parent-offspring covariance) on V_r (array variances), additive effect (D) was larger than dominance one (H_1), and thus this character is recognized to be controlled by incomplete dominant genes. Lower BOR is manifested by dominant genes while recessive genes act towards the opposite direction. Number of effective factors and heritability were estimated as 3 and 0.79, respectively. Epistatic and maternal effects were observed in this character, and the value of the BOR was significantly differed by reciprocal crossing. Correlation between the BOR and the amounts of sericin proteins in cocoon shell were observed to be low ($r=0.4$), although correlation between the amounts of sericin and fibroin proteins in cocoon shell were high ($r=0.9$). From these results, it can be considered that the genes regulating the BOR are different, at least in part, from the genes regulating the amounts of silk proteins and they are located on a few chromosomes. Improvement of the BOR towards low value can be achieved by its selection and by the finding of the crossing types showing higher combining ability. The number of effective genes of the BOR, however, would be more than that of present estimation from eight strains, and fixing the dominant low BOR genes in homozygous state might not be easy.

L'analyse génétique est effectuée sur le taux de décreusage (TD) de la coque soyeuse du ver à soie par croisements dialléliques de 8 souches améliorées. Les résultats de l'évaluation des paramètres génétiques et de l'analyse de régression de W_r (covariances) sur V_r (variances) montrent que l'effet additif (D) est plus important que l'effet de dominance (H_1) ; ce caractère s'avère donc être contrôlé par des gènes dominants incomplets. Le plus faible TD se manifeste sous l'action de gènes dominants tandis que les gènes récessifs agissent en sens inverse. Le nombre de facteurs effectifs est 3 et l'héritabilité est de 0.79. On observe pour ce caractère des effets épistatiques et maternels, et la valeur du TD est sensiblement modifiée par le croisement réciproque. La corrélation entre le TD et les quantités de séricine dans la coque soyeuse est faible ($r = 0,4$), bien que la corrélation entre les quantités de séricine et de fibroïne soit élevée ($r = 0,9$). A partir de ces résultats, on peut considérer que les gènes qui régissent le TD sont différents, au moins en partie, des gènes qui régissent les quantités de protéines de la soie et qu'ils sont situés sur peu de chromosomes. L'amélioration du TD (sa diminution) peut être obtenue par sélection sur ce critère et en trouvant de nouveaux types de croisements montrant une meilleure aptitude à la combinaison. Le nombre de gènes effectifs du TD, cependant, peut être supérieur à celui obtenu dans cette étude de 8 souches, et la fixation des gènes dominants pour obtenir un TD faible dans un état homozygote peut s'avérer difficile.

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GAPUROVA G.N.

Chemical and physicochemical properties of surgical sutures. (Propriétés physiques et physicochimiques des sutures chirurgicales).

Zdravookhr. Turkm., 1983, 27(7), p. 15. (R)

GOSLINE J.M., DENNY M.W., DE MONT M.E.

Spider silk as rubber. (La soie d'araignée utilisée comme le caoutchouc).

Nature, 1984, 309(7), p. 551-552. (E,e)

HATTENSWILLER P.

Observations on quality and behaviour of silk yarns in high production weaving. (Raw and spun silk). (Observations sur la qualité et le comportement des brins de soie lors du tissage à haut rendement (soie grège et soie filée)).

I.S.A. Congress, Venice, 1984. (E) R

HIRABAYASHI K.

Chemical structure and physical properties of silk fibroin. (Structure chimique et propriétés physiques de la fibroïne).

Sen'i Gakkaishi, 1984, 40(4-5), p. 119. (J)

KATAGATA Y.*, KIKUCHI A., SHIMURA K.

Characterization of the crystalline-region peptides prepared from the posterior silk gland fibroin. (Caractérisation des peptides de la région cristalline de la fibroïne préparée à partir de la partie postérieure de la glande séricigène.)

J. Seric. Sci. Jpn., 1984, 53(2), p. 165-174. (E,e) R

Cristalline-region peptides (Cp) of silk fibroin were prepared by α -chymotryptic digestion from the large subunit of fibroin, which was prepared from the posterior silk glands of *Bombyx mori* with cold 30% ethanol treatment. The ratio of crystalline to amorphous regions in the large subunit was about 55 to 45 in terms of amino acid residues. Sephadex G-50 gel filtration gave a single peak with a slight shoulder, indicating the molecular size of Cp lies within a fairly limited range. On the other hand, elution profile of Cp from a column of DEAE-Sephadex A-50 exhibited one main peak with a shoulder and three minor peaks. This result shows the heterogeneity of Cp peptides in respect to their electrostatic charges. Amino acid analysis of these peptide fractions also supports this opinion. Molecular weight of Cp was estimated to be about 3900-4100 from terminal analyses and amino acid composition.

Les peptides de la région cristalline (Cp) de la fibroïne ont été préparés par digestion α -chymotryptique de la grande sous-unité de la fibroïne, elle-même obtenue à partir de la partie postérieure des glandes séricigènes de *Bombyx mori* par traitement à froid dans de l'éthanol à 30 %. Le taux d'acides aminés contenus dans les parties cristallines par rapport aux parties amorphes est de 55 à 45. La filtration sur gel de Sephadex G-50 donne un seul pic avec une légère queue, ce qui indique que la taille moléculaire de Cp se situe dans une fourchette très étroite. D'autre part, le profil d'éluion de Cp à partir d'une colonne de DEAE Sephadex A-50 montre un pic

principal et 3 pics mineurs. Ce résultat indique l'hétérogénéité des peptides Cp par rapport à leurs charges électrostatiques. L'analyse des acides aminés de ces fractions de peptides corrobore ce fait. Le poids moléculaire de Cp est estimé à environ 3900-4100 à partir des analyses finales et de la composition en acide aminé.

KATAGATA Y.*, KIKUCHI A., SHIMURA K.

Fractionation and characterization of the amorphous-region peptides of fibroin prepared from the posterior silk gland. (Fractionnement et caractérisation des peptides de la région amorphe de la fibroïne extraite de la partie postérieure de la glande séricigène.)

J. Seric. Sci. Jpn., 1984, 53(3), p. 226-236. (E,e) R

The amorphous-region peptides obtained by chymotryptic digestion of large sub-unit of posterior silk gland fibroin were fractionated and characterized. The chymotryptic peptides were separated into four groups, S-I, II, III, and IV, by gel filtration on Sephadex G-15 and these four groups occupied about 32, 4, 46, and 17%, respectively, of the total peptides recovered. Each group (S-I to IV) was further fractionated on DEAE-Sephadex A-25 or Dowex-1 column chromatography and proved to be composed of peptide groups having molecular sizes of about 25-35, 8-15, 8-10 and 3-6 amino acid residues, respectively. The amino acid composition of the S-I peptides, a newly found group, was almost the same as that of the crystalline-region peptides of fibroin, but the molecular size of the former was about a half of the latter. S-III was composed of two main octapeptides, which were sequenced to be Gly-Ala-Gly-Ala-Gly-Ala-Gly-Tyr and Gly-Ala-Gly-Val-Gly-Ala-Gly-Tyr.

Nous avons fractionné et caractérisé les peptides de la région amorphe obtenus par la digestion chymotryptique de la grande sous-unité de la fibroïne de la partie postérieure de la glande séricigène. Les peptides chymotryptiques ont été séparés en quatre groupes, S-I, II, III, et IV, par filtration du gel de Sephadex G-15 et ces quatre groupes représentent respectivement 32, 4, 46, et 17 % de la totalité des peptides récupérés. Chaque groupe (S-I à IV) a de nouveau été fractionné sur DEAE-Sephadex A-25 ou par chromatographie sur colonne Dowex-1 et se sont avérés composés de peptides ayant des tailles de 25-35, 8-15, 8-10 et 3-6 acides aminés. La composition en acides aminés des peptides du groupe S-I est presque identique à celle des peptides de la région cristalline de la fibroïne mais la taille moléculaire de ces derniers est deux fois plus faible que celle des premiers. Le groupe S-III se compose de deux principaux octapeptides dont la séquence est Gly-Ala-Gly-Ala-Gly-Ala-Gly-Tyr et Gly-Ala-Gly-Val-Gly-Ala-Gly-Tyr.

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LVOV K.M., ASILYANOV R.B., MAMEDOV S.B.

Kinetic study of radicals death in UV irradiated silk fibroin. (Etude cinétique de la mort des radicaux dans la fibroïne irradiée aux UV).

Biofizika SSSR, 1984, 29(4), p. 537.

MATSUMOTO T., MASAGO Y., SAJIYO M.

On the swelling treatment of silk fabrics. (Traitement gonflant des tissus de soie).

Reports of the Silk Sci. Res. Inst., 1984, 32, p. 73-82. (J,j) R

SHIMOKAWA S.

Carbon 13 nuclear magnetic resonance study of silk protein. (Etude par résonance magnétique nucléaire au carbone 13 des protéines de la soie).

Kogakubu Kenkyu Hokoku (Hokkaido Daigaku), 1984, 117, p. 101-109.

TSUKADA M.*, ISHIGURO Y.

Structural analysis of modified silk by methacrylamide (MAA) grafting. (Analyse de la structure de la soie modifiée par greffage de méthacrylamide (MAA).)

J. Seric. Sci. Jpn., 1984, 53(2), p. 121-126. (J,j,e) R

Studies were made on the structural analysis of the silk thread, modified by the potassium persulfate initiated graft copolymerization of methacrylamide (MAA), by means of differential scanning calorimetry (DSC), thermogravimetry (TG), X-ray diffraction measurement and scanning microscopic observation. By examining the DSC curves of modified silk thread by MAA grafting, the compatibility of MAA grafting-polymer against to the silk fibroin was found to be very low. The percentage of grafting could be estimated roughly from the enthalpic changes appeared on the DSC curves at about 270°C. X-ray diffraction pattern of chemically modified silk by graft polymer was masked by the Debye-Scherrer ring from the diffraction of graft polymer, when the percentage of grafting exceeded the limit by about 40%. Polymethacrylamide appeared to be chemically bonded to the surface of the silk thread, when the percentage of grafting exceed 40%. The decompositional temperature of the modified silk thread decreased as the grafting reaction underwent, while the crystal structure stayed unchanged.

Nous avons effectué des études pour analyser la structure du fil de soie modifié par le persulfate de potassium avant le greffage par copolymérisation de méthacrylamide au moyen de la calorimétrie différentielle à balayage (DSC), la thermogravimétrie (TG), la diffraction aux rayons X et la microscopie à balayage. Selon les courbes DSC du fil de soie modifié par greffe de MAA, la compatibilité du polymère greffé MAA avec la fibroïne est très faible. Le pourcentage de greffe peut être estimé approximativement d'après les variations d'enthalpie apparues à 270° C sur les courbes DSC. Le profil de diffraction aux rayons X de la soie modifiée est masqué par l'anneau de Debye-Scherrer provenant de la diffraction du polymère greffé, quand le pourcentage de greffe dépasse 40 %. Le polyméthacrylamide semble être chimiquement lié à la surface du fil de soie quand le pourcentage de greffe dépasse 40 %. La température de décomposition du fil de soie modifiée diminue à mesure que la réaction de greffage se produit, tandis que la structure cristalline reste inchangée.

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WANG T. et al.

Layers of the silk filament spun by *Bombyx mori* L. of cocoon layer. (Couches du filament de soie filé par *Bombyx mori* L.).

Ganyu Kexue, 1984, 10(3), p. 169-172. (C) R

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On the effects of alkalinity and hardness to solubility of cocoon layer sericine. (Effets de l'alcalinité et de la dureté sur la solubilité de la séricine de la coque soyeuse).

Reports of the Silk Sci. Res. Inst., 1984, 32, p. 53-60. (J,j) R

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