

REVUE DU VER A SOIE

(*BOMBYX MORIL.*)

JOURNAL OF SILKWORM

A V I S

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*Première Partie*

DOMAINE SCIENTIFIQUE

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THE TUSSER SILK INDUSTRY IN VIETNAM  
AND ITS ASPECT

By Mr KATSUMATA F. (Japan) (\*)

In Summer we can see many Tusser silkworms (*Antheraea mylitta*) and their cocoons on Bang Lang trees (*Lagerstroemia Speciosa P.*) in Saigon. During the period, from the middle of July to the end of August, we can observe this wild silkworm in all its stages: eggs, infant larvae, grown larvae, coccooning ones, cocoons with living pupae and adult moths.

It is said that this Tusser silkworm is of a bivoltine species, therefore, it is considered that those cocoons with living pupae and adult moths belong to the first generation of the year, and that those eggs and infant larvae belong to the second generation of the same year. From this fact it is believed that the progress of the growth of this species varies very much according to the individual insect.

FEATURES OF COCOONS AND COCOON-FILAMENTS

First of all, we tested the features of the cocoons and the cocoon filaments of this wild silkworm. Materials for examination were gathered from the Bang Lang trees in Saigon on the end of July 1962. At the time of cooking the cocoons, we tried operations in several concentrated solutions of the sodium carbonate, but we found that cooking the cocoons in water is favorable for reeling operation, and, in reality, we boiled cocoons in water for one hour, during the boiling period coll water was sprinkled on cocoons in order to

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(\*) Mr KATSUMATA, a sericulture technician sent to Vietnam under Colombo plan, c/o THE NATIONAL SERICULTURE STATION, BAC-LOC (Vietnam).

facilitate the penetration of the water into the cocoon-cavity. After this operation the cocoons were left in the hot water for five hours, then the cooking basin was again warmed to about 90°C temperature and the reeling operation was conducted. The reeling operation was performed by the single cocoon reeling method.

1°) *QUALITY OF COCOONS.*

The weight of a single cocoon is about 8.4 gm for the female cocoon and 5.39 gm. for the male cocoon, the weight of a single cocoon shell is about 0.63 gm. for the female cocoon and 0.53 gm. for the male one, and the percentage ratio of cocoon shell to cocoon weight is 7.5 % for the female cocoon and 9.8 % for the male one. Details are as follows :

Numbers of cocoons	Female			Male		
	Weight of a single cocoon	Weight of single co- con shell	Percentage	Weight of a single cocoon	Weight of a single cocoon shell	Percentage
			ratio of a cocoon shell to a cocoon weight			ratio of cocoon shell to cocoon weight
(gm)	(gm)	(%)	(gm)	(gm)	(%)	
N° 1	8.27	0.62	7.48	5.5	0.56	10.18
2	9.15	0.70	7.65	5.7	0.56	9.82
3	8.87	0.69	7.78	5.8	0.57	9.82
4	7.00	0.50	7.14	5.4	0.50	9.26
5	8.90	0.62	6.96	4.55	0.45	9.89
Average	8.43	0.63	7.5	5.39	0.53	9.8

2°) *QUALITY OF COCOON-FILAMENTS.*

The length and weight of the cocoon filaments vary very much according to the individual cocoon, so that, we cannot average the figure obtained by examinations.

As for the length of the cocoon-filaments the longest one measured 615 meters, the shortest one 210 meters and the medium one about 400 meters in length.

Regarding the weight of cocoon-filaments the heaviest one weighs 44 cg., the lightest one 18 cg. and the medium one about 30 cg.

The variability in the length and the weight of cocoon-filaments is, need-less to say, due to the great difference among the unwinding quality of cocoon-filaments.

The results of examination show that the size of cocoon-filaments may, ordinarily, be 6.0 to 6.5 deniers in thickness.

Details are as follows :

Number of cocoons	Length of cocoon filaments	Weight of cocoon filaments	Size of cocoon filaments	Time broken
	(m)	(cg)	(denier)	
N° 1	427	33,38	7,76	0
2	337	29,00	6,40	0
3	570	36,25	5,72	0
4	418	25,63	5,54	0
5	240	48,00	7,82	2
6	615	44,38	6,50	0
7	360	30,00	7,50	2
8	469	37,50	7,19	0
9	258	21,50	7,47	1
10	397	27,50	6,25	0

### 3°) COCOON COLOR

The most excellent property of this Tusser silkworm is the white color of cocoons.

### FUTURE PROSPECT AND PROBLEMS TO BE SOLVED

The Indian Tusser silkthreads are a very famous, excellent and strong one. Since 1958 the Indian Tusser silk has been an important export goods to the United States of America.

It is needless to say that the Tusser silk industry in Vietnam is very hopeful, but, we think

that a lot of this kind of silks threads should be gathered in order to export it to foreign countries, and that a mass production of the Tusser silk on a commercial base will need to put in much effort for the country, because there is no facilities for improving the Tusser silk industry in Vietnam at the present time. Therefore, if it is required to develop this industry, we must start an experiment to improve the quality of cocoons and cocoon-filaments, because as mentioned above, the existing wild Tusser silkworms in Vietnam are very variable in quality of their cocoons.

According to our observations, the point of the cocoon shell, which hinders the unwinding of cocoon-filaments, is the upper part of cocoons just under the base of the peduncle. This part of Tusser cocoons corresponds to the opening point of *Philosamia* cocoons. Therefore, it is necessary to select and breed the Tusser silkworm race, which has a favorable feature for unwinding the cocoon-filaments.

What is more, outdoor experiments in rearing silkworms and experiments in reeling cocoons are essential for developing the Tusser silk industry in Vietnam.

#### BEHAVIOR OF ADULT MOTHS

##### TIME FOR EMERGENCE OF ADULT MOTH

Like *Philosamia* moths Tusser silkworm moths emerge in the evening, usually from dusk to about 10 p.m.

##### FROM EMERGENCE TO THE COMPLETION

##### OF THE BODY CONDITION OF THE MOTHS

When the adult moths emerge, they hang onto their cocoons or other substance nearby and stretch their wings. Examples are as follows:

##### IN CASE OF A FEMALE MOTH

About two hours before emergence, the upper portion of the cocoon becomes wet from saliva secreted by the moth. Fifteen minutes before emergence a

small hole is pierced in the cocoon shell by the moth. Five minutes before emergence the hole becomes larger and the head of the moth can be seen from the outside. The period required for emergence of a moth is about 40 seconds. At the beginning the emerged moth's wings are shorter than the body, but five minutes after emergence the wings begin to stretch and become about the same length as the body length. Nineteen minutes after emergence, the wings stretch fully and hang over the abdomen. Sixty five minutes after emergence, the wings become normal.

*IN CASE OF A MALE MOTH*

Fifteen minutes after emergence, the wings stretch fully, and sixty minutes after emergence the body condition seem to become normal.

*SIZE OF MOTHS*

Size of moths emerging during the first ten days of August, 1962, were as follows :

Number of moths	Female		Male	
	Length of the body	Length of the extended wings	Length of the body	Length of the extended wings
	(m.m.)	(m.m.)	(m.m.)	(m.m.)
N° 1	53	166	30	125
2	45	152	30	127
3	43	160	34	141
4	35	160	33	135
5	45	160	30	140
Average	44	160	31	134

*LAYING EGGS AND THE LONGEVITY OF MOTHER MOTHS*

The moths emerging in the evening mate on the night of the day they emerge or on the following day. Usually the mother moth lays eggs on the night, from the third day after emergence to the day of their death, that is, about one week. They do not lay eggs during the day time, and egg-laying is done from dusk to dawn of the next morning.

*NUMBER OF EGGS LAID BY A MOTHER MOTH*

Number of eggs laid by a mother moth are 300 to 400 eggs and they are laid for several days, some examples follow :

Number of moths	Number of eggs laid each day		
	N° 1	N° 2	N° 3
	(eggs)	(eggs)	(eggs)
On the night of the third day after emergence	223	172	279
" fourth day "	127	99	62
" fifth day "	35	16	0
" sixth day "	15	22	0
" seventh day "	28	20	0
" eighth day "	14	6	died
" ninth day "	9	4	-
" tenth day "	1	1	-
" eleventh day "	1	died	-
" twelfth day "	died	-	-
Total	453	340	341
Eggs remained in the mother body	0	0	62

*LONGEVITY OF MOTHER MOTHS*

From the above table it can be seen that the mother moth's life span is from 7 to 10 days.

*WEIGHT OF EGGS*

An egg weighs about 7 m.g. , but it becomes smaller with the later days of deposition.

The days of deposition	Weight of a single egg (m.g.)	Number of eggs per one gram (eggs)
Eggs laid on the night of the third day	7.575	132
" " " fourth day	6.944	144
Eggs laid on the night of the fifth day to the eighth day	6.111	163

*THE LENGTH OF THE EMBRYONAL STAGE AND THE HATCHING TIME*

Eggs laid on the night of the first day of August hatched mainly in the morning of the ninth day of the month. Therefore it can be said that the length of the embryonal stage of this silkworm is about 7 days and several hours. Some examples are sited below :

Time of hatching	Number of larvae hatched	
	Batch N° 1 (larvae)	Batch N° 2 (larvae)
4 a.m. - 6 a.m. first day	3	2
6 - 8	135	36
8 - 10	50	16
10 - 12	11	8
12 - 2 p.m.	2	5
2 - 4	1	5
4 - 6	3	3
6 - 8		1
8 - 10		5
10 - 4 a.m. second day		8
4 - 6		1
6 - 8		4
8 - 10		3
10 - 12		2
Unhatched eggs		2 eggs

From the table it can be seen that eggs usually hatch in the morning, but a small number of eggs hatch in the afternoon or on the night.

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RESUME

L'INDUSTRIE DE LA SOIE SAUVAGE AU VIETNAM.

1°) Le ver à soie Tasar (*Antheraea mylitta*) existe au Vietnam. On peut le rencontrer à tous les âges en été juillet et août : sous forme d'oeufs, de larves jeunes et adultes, de larves filant leurs cocons, de chrysalides et de papillons.

On dit que c'est un ver à soie d'espèce bivoltine c'est pourquoi l'on considère que quelques uns des cocons contenant des chrysalides vivantes ainsi que les papillons appartiennent à la 1ère génération de l'année et que les oeufs et les jeunes larves appartiennent à la seconde génération de la même année.

2°) Un cocon femelle pèse environ 8,4 gr et un cocon mâle 5,4gr. La coque pèse 0,63 gr pour la femelle et 0,53 gr pour le mâle. Le rapport poids de la coque/poids du cocon est environ 7,5 % pour la ♀ et 9,8 % pour le ♂.

3°) La longueur du filament constituant le cocon est très variable selon les individus. Les plus longs brins mesurent 615 mètres, les plus courts 210 m. et les moyens 400m.

4°) Le poids du brin varie également beaucoup : les plus lourds pèsent 44 cg, les plus légers 18 cg et les moyens environ 30 cg.

5°) La variabilité des longueurs et des poids des brins vient de la grande différence existant entre les qualités de dévidage des cocons.

6°) Le titre du brin varie de 6,0 à 6,5 deniers,

7°) La couleur du cocon est blanche,

8°) Les papillons adultes sortent des cocons le soir entre le coucher du soleil et 10 h du soir,

9°) Le papillon atteint l'état d'insecte parfait dans les deux heures suivant sa sortie du cocon,

10°) Les papillons ♀ mesurent environ 43 mm de long et ont une envergure de 160 mm ; les papillons ♂ mesurent environ 30 mm et leur envergure est de 130 mm,

11°) La ponte s'effectue pendant la nuit à partir du 3ème jour de la sortie et jusqu'à la mort,

- 12°) La ♀ pond de 300 à 400 oeufs pendant plusieurs jours,  
13°) La vie d'une femelle est de 7 à 10 jours après la sortie du cocon,  
14°) Un oeuf pèse environ 7 mgr. mais il perd du poids pendant les jours qui suivent la ponte,  
15°) L'âge embryonnaire dure 7 jours et quelques heures,  
16°) L'éclosion des oeufs a lieu au matin en général mais quelques oeufs peuvent éclore le soir ou pendant la nuit,  
17°) Les arbres utilisés pour l'élevage des vers à soie à Saïgon sont : Le Bang-Lang (Lagerstroemia speciosa pers.)  
l'arbre Daû (Dipterocarpus alatus)  
l'arbre Sao (Hopea odorata)

18°) L'industrie du ver à soie sauvage Tasar au Vietnam est excellente dans les conditions naturelles mais la production massive de fil de soie Tasar à l'échelle commerciale réclame un grand effort de ce pays parce que à l'heure actuelle il n'est fait aucune facilité pour le développement de cette industrie au Vietnam,

19°) En vue de développer l'industrie de la soie Tasar il est indispensable de sélectionner et d'élever une race possédant de meilleures qualités au dévidage.

SUPPLEMENT : Selon de récentes observations cependant, il est confirmé que le ver à soie Tasar au Vietnam : Antheraea mylitta appartient à l'espèce polyvoltine, c'est la raison pour laquelle ce ver à soie sauvage est élevé toute l'année à Saïgon.

RECONNAISSANCE : L'auteur exprime ses remerciements au Pr Pham-Hoang Ho de la Faculté des Sciences, Université de Saïgon, qui l'a aidé dans l'identification des arbres utilisés pour l'alimentation du ver à soie.

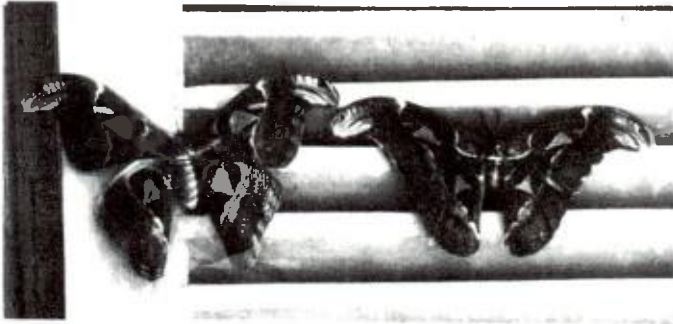
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1 - Cocoons



3 - Larvae



2 - Moths



4 - Cocoons

OBSERVATIONS ON THE BEHAVIORS OF THE *ATLAS MOTH*  
*PHILOSAMIA ATLAS* L. REARED INDOORS IN SUMMER, 1962.

By Mr KATSUMATA F. (Japan) (\*)

The eggs for this examination were laid at dawn of the 18th day of May, 1962. They were kept in a room of 26°C to 29°C in temperature for incubation. The larvae hatched on the morning of the 26th day of May between 7 and 8 a.m.

The larvae were supplied with leaves of *Cây Oi* (*Psidium guajava*) extending over the entire larval stage and reared in a room with the temperature varying from 25°C to 29°C.

1 - LENGTH OF LARVAL STAGE.

The length of the larval stage varies very much according to the individual larva, especially the progress of growth of each larva became irregular in later stages, fifth and sixth stages. The beginning of each stage is roughly estimated as follows :

Time for starting each stage

Time for starting each stage						Mounting
(first	2nd stage	3rd stage	4th stage	5th stage	6th stage	(about
feeding)						90 % of
						larvae)
10 a.m.	10 a.m.	10 p.m.	5 p.m.	6 p.m.	10 a.m.	12 (noon)
26th May	30th May	3rd June	8th June	14th June	24th June	9th July

(\*) Mr KATSUMATA, a sericulture technician sent to Vietnam under Colombo plan, c/o THE NATIONAL SERICULTURE STATION, BAC-LOC (Vietnam).

*LENGTH OF EACH STAGE*

1st stage		2nd stage		3rd stage		4th stage		5th stage		6th stage		Total	
days	hours	d.	h.	d.	h.	d.	h.	d.	h.	d.	h.	d.	h.
4	0	4	12	4	19	6	1	9	16	15	4	44	2

*ACTUAL LENGTH OF LARVAL STAGE OF INDIVIDUAL LARVA*

The above figures are the approximate length of the larval stage, but, the actual length of the larval stage of the individual larva is as follows :

Date of mounting	Actual length of larval stage		Female larvae	Male larvae	
	days	hours	(larvae)	(larvae)	
July	1.	36	2	0	2
	3.	38	2	1	1
	4.	39	2	1	1
	5.	40	2	0	2
	6.	41	2	4	2
	7.	42	2	0	1
	8.	43	2	3	3
	9.	44	2	1	1
	11.	46	2	2	0

Note : Larvae used to mature about at noon.

According to the above table, the average length of the larval stage is 40 days 13 hours for the male larvae and 42 days 6 hours for the female larvae. The shortest one was 36 days 2 hours and the longest one was 46 days 2 hours.

2 - BEHAVIORS OF LARVAE

A) *Hatching behavior* : the larvae hatch in the morning, from seven to eight a.m. After coming out of eggs the larvae eat the egg shell.

B) *Behavior of eating leaves* : the larvae eat leaves from the edge, even though the larvae are infant just after the hatching. This behavior is diffe-

rent from that of the infant domestic silkworm larvae.

C) *Resting behavior in earlier stages* : Infant larvae bend the anterior part of their body sideways at the time of rest. This behavior is seen even at the molting period of their infant stages.

D) *Molting behavior* : just before casting the skin off, the larva straightens its body and strains itself toward the anterior part, slipping the old skin backwards. The old skin, at last, breaks at the border of the head and the thorax, and the new molted larva comes out of the old skin, casting it off. The length of the period for casting the old skin varies according to the age of the larvae.

E) *Period for molting and exuviation* : The period for molting means the period from the time they cease eating leaves to the beginning of the exuviation, and the period for exuviation means the period from breaking the old skin at the border between the head and the thorax to completion of the exuviation.

	Period for molting		Period for exuviation	
	N° 1	N° 2	N° 1	N° 2
	(hours)	(hours)	(minutes)	(minutes)
1st molting	20	-	2	3
2nd "	16	17	3	-
3rd "	22	20	4	4
4th "	28	29	8	6
5th "	35	34	8	7

Note : - means that the chance for survey was lost.

F) *Period from the end of the exuviation to the completion of various body conditions* :

	1st molt		2nd molt		3rd molt		4th molt		5th molt	
	(minutes)		(minutes)		(minutes)		(minutes)		(minutes)	
	N°1	N°2	N°1	N°2	N°1	N°2	N°1	N°2	N°1	N°2
To the beginning of stretching dorsal thorns	9	7	6	6	-	-	-	-	7	8
To the end of stretching dorsal thorns	14	10	9	9	10	9	10	10	12	13
To the beginning of blacking of larval antennae					35	26	22	24	34	38
To the end of blacking of larval antennae					-	60	-	-	72	78
To the beginning of eating exuvia	69	60	78	70	87	77	83	98	114	115
To the end of eating exuvia	117	75	92	85	97	99	113	119	163	186
To the beginning of eating leaves	222	100	222	176	184	181	186	183	243	268
To the first excretion	279	230	304	270	272	339	317	417	528	548

Note : (1) - means that the chance for the survey was lost.

(2) Larval antennae can not be distinguished on the body of the first and the second instar larvae.

We think that the time of the beginning of eating the exuvia is the time, when the body condition of the newly molted larvae is completed.

According to the above table it is seen that the body condition of the second instar larvae is completed about one hour (60-69 minutes) after the exuviation of the first molt and that of the sixth instar larvae is completed about two hours (114 and 115 minutes) after the exuviation of the fifth molt, and the periods for the third, fourth and fifth instar larvae are laid between the above two.

G) *Excretion of soft and watery faeces, and shrinkage in body-size of mature larvae.*

Larvae begin to shrink their body-size one day before mounting, and around the noon of the mounting day they excrete soft and watery faeces, shrinking their body size extremely. The time of excreting the

soft and watery faeces is centered around noon, from eleven a.m. to two p.m. and the larvae do not excrete those faeces at any other time. The soft and watery faeces are the last excrements for the mature larvae, and the number of dropping in the soft faeces varies according to the individual larva, from one to four, and those faeces are coated with a thin membrane, making a connected line. After the excretion of the soft faeces the watery excrement comes out, being divided into several drops in several times, the watery excrement is brown or light brown in color at the beginning and it becomes colorless at last.

As to the shrinkage in body size of larvae, we surveyed two cases, that is, larvae sized 95m.m. and 90 m.m. in body-length at their full grown stage reduced to 70 m.m. and 65 m.m. respectively after the excretion of the watery faeces.

H) *Period from excretion of soft faeces to spinning cocoons.*

The periods from the excretion of the soft faeces to the excretion of the watery faeces, the move to seek cocooning places and the time for beginning to spin cocoons are as follows :

Number of larvae		N°1	N°2	N°3
		(minutes)	(minutes)	(minutes)
From the excretion of the soft faeces	To the watery excrement in larger amount	2	5	3
	To the last watery excrement	5	12	10
	To the grasping of twigs by caudal legs	9	17	12
	To the move to seek cocooning places	14	21	-
	To the start of spinning cocoons	8 hours	13 hours	9 hours

I) The behavior of biting the petioles and drooping the leaves.

At the time of making cocoons, larvae bite the petioles and droop them downward to make cocoons on them. Moreover, white powder-like-substance is put there-about by the mature larvae.

This behavior can not be seen at the time of the mounting of Tusser silkworms.

J) Period for spinning cocoons.

As to the period for spinning cocoons it is generally said that larvae spin cocoons for two to three days, after excreting the last faeces, for instance, we observed the following cases: a larva spins its cocoon for 53 hours, the second one for 65 hours and the third one for 72 hours respectively.

K) Period from mounting to pupation.

Regarding the period for pupation it is generally said that larvae turn into pupae in six to seven days after the mounting. In reality, we observed the following cases: a larva turned into pupa after 6 days 12 hours, 6 days 17 hours, 6 days 19 hours and 6 days 20 hours after mounting.

3. FEATURES OF COCOONS

OBTAINED BY THE INDOOR REARING

Cocoons obtained by the indoor rearing are inferior to those produced on the wild trees in quality. The following figures are average values.

Female			Male		
Weight of a single cocoon	Weight of a single cocoon shell	Percentage ratio of cocoon shell to cocoon weight	Weight of a single cocoon	Weight of a single cocoon shell	Percentage ratio of cocoon shell to cocoon weight

Cocoons	(g)	(g)	(%)	(g)	(g)	(%)
indoor	6.40	0.46	7.5	4.42	0.41	9.2
"wild	9.50	0.85	3.9	6.67	0.74	11.1

Note: Cocoons obtained from wild trees were made in the same season as those obtained by the indoor rearing.

#### 4. LENGTH OF PUPAL STAGE (FROM MOUTING TO EMERGENCE OF THE MOTHS)

The length of the pupal stage varies considerably according to the individual pupa, we obtained the following data in surveying this feature of the Atlas moth reared indoors in June, 1962. That is, 25 larvae were mounted at the beginning of July, from the first day to the eleventh day, out of which 18 pupae developed into moths and 7 pupae are yet in their pupal stage at the present time (September 10th, 1962).

The length of pupal stage of each insect is as follows :

Length of pupal stage	Number of moths emerged out of pupae	
	Female	Male
24 days	1	0
25 "	1	3
26 "	3	1
27 "	1	0
28 "	1	1
29 "	1	1
34 "	0	1
45 "	0	2
50 "	0	1
Number of pupae remained in their pupal stage	4	3

Note : In relation to the length of the pupal stage the problem of the diapausing pupae will arise in researches of this insect.

#### 5. SIZE OF MOTHS REARED INDOORS

In accordance with the decrease in the cocoon weight, the size of the moths reared indoors is smaller than that of the wild moths. A result of the survey is as follows :

Number of moths	Female		Male	
	Length of the body	Length of the extended wings	Length of the body	Length of the extended wings
	(m.m.)	(m.m.)	(m.m.)	(m.m.)
Nº 1	35	195	30	180
2	43	195	30	180
3	40	205	35	180
4	50	200	30	175
5	45	200	30	170

6. NUMBER OF EGGS LAID BY A MOTHER MOTH REARED INDOORS

The number of the eggs laid by a mother moth reared indoors is less than that of those eggs laid by a wild mother moth. Details are as follows :

	Number of eggs laid each day				
	Moth				
	Nº 1	Nº 2	Nº 3	Nº 4	Nº 5
At dawn of the fourth day after emergence	99	76	46	90	111
" the fifth day	11	23	18	29	34
" the sixth day	6	29	15	22	14
" the seventh day	0	12	8	18	12
" the eighth day	0	14	(died)	8	5
" the ninth day	(died)	5		2	3
" the tenth day		(died)		(died)	2
					(died)
TOTAL	116	159	87	169	181
Eggs remaining in the mother's body	2	7	3	8	0

7. LONGEVITY OF MOTHER MOTHS

According to the above table the life span of the mother moth reared indoors is about the same as that of the wild moth described in the previous paper.

8. WEIGHT OF EGGS LAID BY MOTHER MOTHS REARED INDOORS

An egg weighs 8.62 m.g. and number of eggs per one gram was 116. These values are smaller than those of the wild moth described in the previous paper.

### 9. FOOD PLANT FOR ATLAS MOTH IN SAIGON

Atlas moth-larvae are fed on the leaves of the following plants.

Cây Oi (*Poidium guajava*)  
Cây Dai Ngua (*Swietenia macrophylla*)  
Cây Khê (*Averrhoa carambola*)  
Cây Gao (*Nauclea annamensis*) ----- discovered  
by Mr. Ruyen.

#### RESUME.

#### OBSERVATIONS SUR LE COMPORTEMENT DU PAPILLON ATLAS (*PHILOSAMIA* ATLAS) ELEVE EN MAGNANERIE PENDANT L'AUTOMNE 1962

1°) La durée de l'âge larvaire varie considérablement selon les larves : 40 jours et 13 heures pour les ♂ et 42 jours et 6 heures pour les ♀, sont les durées moyennes ; 36 jours 2 heures représentent la durée minimum et 46 jours 2 heures la durée maximum.

2°) Quant au comportement des larves, les faits suivants sont à noter :

a) Les larves éclosent au matin, elles mangent le coquille des oeufs après l'éclosion,

b) Les jeunes larves, immédiatement après l'éclosion commencent à manger le bord des feuilles,

c) Quand elles se reposent, les jeunes larves penchent la partie antérieure de leurs corps sur le côté,

d) Le temps de mue varie selon l'âge des larves ; la seconde mue est la plus courte elle dure de 16 à 17 heures ; la 5ème mue est la plus longue, elle dure de 34 à 35 heures,

e) Le temps d'exuviation varie également en fonction de l'âge des larves : le temps d'exuviation de la première mue est le plus court (2 à 3 minutes), celui de la 5ème mue le plus long (7 à 8 minutes),

f) Le temps qui s'écoule entre la fin de l'exuviation et le moment où les larves commencent à manger les exuvies est considéré comme le temps nécessaire à l'achèvement du corps de la larve après la mue. La durée de ce temps, selon nos observations, varie suivant l'âge de la larve, c'est à dire qu'il dure une heure après la 1ère mue et 2 heures environ après la 5ème. Pour les 2ème, 3ème et 4ème mues cette période varie entre 1 et 2 heures,

g) Les larves mûres excrètent des matières souples et hydratées qui sont les derniers excréments de la larve,

h) Les larves mûres voient leurs corps diminuer de volume après avoir excrété,

i) L'excrétion des fèces se produit aux environs de midi et les larves commencent à filer leurs cocons environ une demie journée après les dernières excrétions,

j) Les larves mûres coupent les pétioles, ainsi elles peuvent faire leurs cocons dans les feuilles fanées,

k) les larves mûres filent leurs cocons pendant les 2 ou 3 jours après la dernière excrétion,

l) les larves mûres se transforment en chrysalides pendant les 6 à 7 jours qui suivent la montée,

m) cet insecte appartient à une race à cinq mues,

3°) Les cocons ainsi produits sont de qualité inférieure par rapport à ceux des larves sauvages,

4°) Le temps de pupaison (de la montée à l'apparition des papillons) varie considérablement selon les chrysalides. Dans notre expérience 25 larves sont montées au début du mois de juillet et elles ont été transformées en chrysalides 7 jours après la montée. De ces 25 larves, 14 papillons sont sortis 24 ou 29 jours après la montée, un papillon est sorti le 34<sup>ème</sup> jour, 2 autres sont sortis le 45<sup>ème</sup> jour et un dernier le 50<sup>ème</sup> jour. Sept chrysalides restent encore dans leur état ce jour 10 septembre 1962, deux mois après la montée.

Le temps de pupaison est étroitement lié à la diapause de la pupe. On dit que ces insectes appartiennent à une espèce bivoltine et les oeufs utilisés pour notre expérience ont été pondus par une femelle qui était issue d'une pupe après diapause ; les problèmes du voltinisme et de la diapause de cet insecte devront être éclaircis ultérieurement.

5°) Les papillons élevés en magnanerie sont de taille plus petite que ceux élevés dans la nature,

6°) Le nombre des oeufs pondus par une ♀ élevée en magnanerie est moindre que celui des oeufs d'une ♀ élevée dans les conditions naturelles

7°) La durée de la vie d'une ♀ élevée en magnanerie est sensiblement la même que celle d'une femelle sauvage,

8°) Le poids des oeufs de femelles domestiquées est inférieur à ceux des oeufs de ♀ sauvage,

9°) Quant aux plantes utilisées pour la nourriture des larves de Phyllosamia atlas elles sont de 4 sortes.



Fig. 1 - Eggs



Fig. 2 - Larvae



Fig. 3 - a cocoon

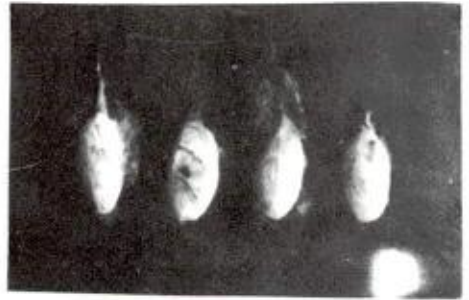


Fig. 4 - Cocoons

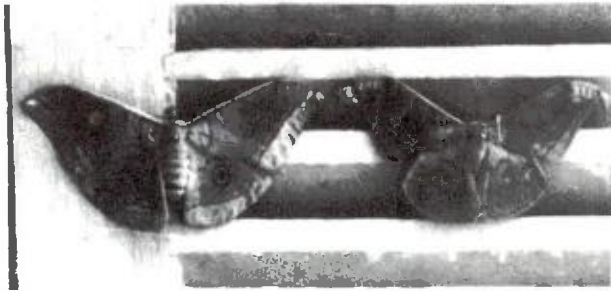


Fig. 5 - Moths

AN EXAMINATION FOR MAKING FLOSS-SILK  
FROM COCOONS OF ATLAS MOTH SILKWORMS

By Mr KATSUMATA F. (Japan) (\*)

The cocoon-shell of the Atlas moth-silkworms makes a strong wall, being kneaded by a gummy substance secreted by the cocooning larvae. Consequently, it is hard to reel the cocoon-filaments from the cocoons.

It is, therefore, considered that these cocoon-filaments can be utilized by silk-spinning operation that is, the strong cocoon-shell be firstly loosened and made into the floss-silk, after that the spun silk yarn be produced.

According to the private communication from Dr. S. Bitô, a research officer of the sericultural experiment station of the government of Japan, the cocoon-shell of Atlas moth is to be boiled in a 1/10 normal solution of Sodium Carbonate for one to two hours in order to loosen the cocoon-filaments in the cocoon-shell.

Taking his advice, we made an examination for making floss-silk from cocoons of Atlas moth.

*Materials* : Material cocoons were gathered from the trees lining the streets of Saigon on the beginning of October 1962. All cocoons were pierced ones. The exuviae of mature larvae and pupae in the cocoons were taken out by cutting cocoon-shell. 70 grams of the cleaned cocoon-shell were obtained from 100 grams of cocoons, this amount of cocoons being, usually, counted for 100 to 105 in number.

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(\*) Mr KATSUMATA, a sericulture technician sent to Vietnam undercolombo plan, c/o THE NATIONAL SERICULTURE STATION, BAC-LOC (Vietnam).

*Method* : 70 grams of cocoon-shell were boiled in 4 liters of a 1/10 normal solution of Natrium Carbonate for 90 minutes and left for several hours until they became cool as they are, after that the floss-silk was made and washed thoroughly with water and the floss-silk was dried up.

*Results* :

Number of experiments	Weight of cocoons used (grams)	Number of cocoons used (cocoons)	Weight of cocoon-shell used (grams)	Weight of floss-silk obtained (grams)	Percentage ratio of floss silk to the weight of cocoons used (%)
I	100	104	70	57	57.0
II	52	50	36	30	57.6
III	51	50	-	26	50.9

Note : In case of experiment III, cocoons were not opened and exuviae were not eliminated. In this case the floss obtained was beaten to remove the pieces of the exuvia in it.

RESUME

ESSAI D'OBTENTION DE BOURRE A PARTIR DES COCONS DU PAPILLON ATLAS.

Le cocon du papillon Atlas se présente sous la forme d'une coque dure, comportant une gomme solidifiée ; c'est pourquoi il est difficile de dévider la soie qui le constitue.

Pour utiliser ce filament de soie il est recommandé de ramollir le cocon, de le transformer en bourre puis en fil de soie.

Pour dégommer les cocons il faut les faire bouillir dans une solution à 1/10 de carbonate de soude pendant 1 à 2 h et la bourre sera ainsi faite.

La qualité de filocelle obtenue représentait environ le 55 % du poids des cocons.

REFERENCE.

Bito, S. (1941) : chemical studies on the silk-thread of the wild silkworms. (V) on the degumming of the cocoon-filaments of wild silkworms (in Japanese), Journal of the sericultural science of Japan Vol. 12, N° 1.

SUPPLEMENT

According to the writer's observation, the Atlas moth larvae are healthy by nature, therefore, if they are raised artificially, the spun silk yarn will be made in mass in Vietnam.

THE EFFECT OF FEEDING THE SILK WORM BOMBYX MORI L.  
WITH DIFFERENT MULBERRY VARIETIES  
ON THE FECUNDITY OF MOTHS.

By M. HASSANEIN M. H.  
and EL SHAARAWY M.F. (Egypt, U.A.R.) (\*)

*INTRODUCTION*

Feeding of the silk worm *Bombyx mori* L. on the mulberry leaves is affected so greatly with the nutritional value of the different mulberry leaf varieties.

These studies has been carried out in the Faculty of Agriculture, Ain Shams University, and the Sericulture Research Section, Ministry of Agriculture, Egypt. It was also conducted in the Sericulture Research Station, Padova, Italy. These studies were carried out to evaluate the effect of feeding with certain mulberry leaf varieties on the fecundity of moths and the egg production.

*REVIEW OF LITERATURE*

Hiratsuka (1920), indicated that the quantity of egg laid by 1000 moths is 391.09 gm. in fresh and 135.55 gm in dry matter, the female moths loosing about half of her own bodily constituents as eggs (in the case of glycogen, as much as 77 %).

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(\*) Mr HASSANEIN (M.H.), (Ph.D. London), Head of Plant Protection Department Assiout University, Assiout, and Mr EL-SHAARAWY (M.F.), (Ph.D. Ain Shams), Sericulture Research Department Ministry of Agriculture, Dokki.

Baud (1960), carried out biochemical researches on *Bombyx mori* L. aiming to explain some physiological phenomena connected with reproduction and nutrition. As for reproduction she had particularly studied the variability of phosphorous content in the ovocytes of normal moth. In her research work on nutrition she first considered the variation of total phosphorous of the eggs in relation to alimentation, secondary she analysed the reserve (glycogen lipids and phosphorous) of the larva brought up on mulberry leaves and on various Succedanea.

#### MATERIALS

##### *Silk worm races :*

The silk worm races used in the present study were the standard breeds reared in certain Mediterranean and the far east countries of the world.

During 1959 and 1960 breeding of the silk worm was carried out in the Sericulture section, Faculty of Agriculture Ain Shams University and the Sericulture Department, Ministry of Agriculture, Egypt, U.A.R. In 1961, breeding was carried out in the Sericulture Experimental Station, Padova, Italy.

The silk worm races used in these studies were :

The race Var, considered as a local race and was reared in 1959,

The cross-breed Yinhan x Huachiu was reared in 1960,

The race 49 M. was reared in the rearing season of 1961 in Italy.

##### *Mulberry varieties :*

The mulberry leaves used for feeding the silk worm were :

1959 and 1960				1961			
Morus alba var.	Morettiana	Morus alba var.	Giazzola				
"	"	"	Japanese L.	"	"	"	Florio
"	"	"	Selvatica	"	"	"	Selvatica
"	"	"	Rosa di Lombardia	"	"	"	Cattaneo
"	"	"	Roumi	"	"	"	Kokuso
"	"	"	Lhu	"	"	"	Morettiana

RESULTS AND DISCUSSION

Weight of pupa :

The change from the larva to the pupa usually begins with cessation of feeding. The larva deserts the mulberry leaves and wanders in search of suitable site for pupation. The average weight of the pupa in the different varieties after feeding on the leaves of different mulberry varieties is recorded in Tables (1 and 2).

TABLE 1.

MEAN WEIGHT OF PUPA, AFTER FEEDING THE LARVA ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Mulberry variety	Weight of pupa (gm.)		
	Min.	Max.	Mean $\pm$ S.D.
	(1959)		
Morettiana	1.030	1.630	1.293 $\pm$ 0.181
Japanese L.	1.000	1.800	1.451 $\pm$ 0.300
Selvatica	1.000	1.450	1.185 $\pm$ 0.141
Rosa di Lombardia	0.940	1.400	1.127 $\pm$ 0.164
Roumi	1.000	1.820	1.247 $\pm$ 0.131
Lhu	0.870	1.320	1.158 $\pm$ 0.260
	(1960)		
Morettiana	1.050	1.600	1.270 $\pm$ 0.173
Japanese L.	1.000	1.820	1.554 $\pm$ 0.223
Selvatica	0.900	1.670	1.220 $\pm$ 0.223
Rosa di Lombardia	0.900	1.350	1.095 $\pm$ 0.137
Roumi	0.930	1.390	1.109 $\pm$ 0.151
Lhu	0.750	1.200	0.970 $\pm$ 0.151

TABLE 2.  
MEAN WEIGHT OF PUPA, AFTER FEEDING THE LARVA ON THE DIFFERENT  
MULBERRY LEAF VARIETIES.

Mulberry variety	Weight of pupa (gr.)		
	Min.	Max.	Mean±S.D.
		(1961)	
Glazzola	1.10	2.01	1.53±0.25
Florio	1.00	2.00	1.38±0.21
Selvatica	1.00	2.05	1.53±0.25
Cattaneo	1.03	1.86	1.43±0.20
Kokuso	1.13	2.20	1.52±0.27
Morettiana	1.01	1.66	1.39±0.21

The average weight of pupa of the race Var ranged from 1.127 gm, to 1.451 gm. The highest mean weight of pupa was that of the worms fed on the leaves of the variety Japanese L. and the minimum weight of pupa was that of the larva fed on the leaves of the variety Selvatica.

The average weight of pupa of the cross breed Yinhan ranged from 0.970 to 1.354 gms. The heaviest weight of pupa was that of the larva fed on the leaves of the variety Japanese L. and the minimum weight was that of the larva fed on the leaves of the variety Lhu.

The average weight of pupa of the race 49 M. ranged from 1.38 to 1.53 gms. The heaviest weight of pupa was that of the larva fed on the leaves of the varieties Glazzola, and Selvatica and the minimum weight was of the larvae fed on the leaves of the variety Florio.

*Weight of female moth :*

Table (3) represents the effect of feeding with the leaves of different mulberry varieties on the average weight of the female moth of the different races of the silk worm *Bombyx mori* L. The average weight of the female moth of the race Var was 0.87, 0.91 and 0.89 gm, after feeding on the leaves of the varieties Morettiana, Japanese L. and Selva-

TABLE 3.

AVERAGE WEIGHT OF FEMALE MOTH PER GM. AFTER FEEDING THE LARVA ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Mulberry varieties	1959			1960			Mulberry varieties	1961		
	Min.	Max.	Mean±S.D.	Min.	Max.	Mean±S.D.		Min.	Max.	Mean±S.D.
Morettiana	0.492	1.00	0.87±0.15	0.742	0.97	0.88±0.05	Giazzola	0.95	1.25	1.14±0.09
Japanese L.	0.672	1.03	0.91±0.12	0.770	1.00	0.95±0.06	Fiorio	0.75	1.25	0.96±0.10
Selvatica	0.682	1.01	0.89±0.11	0.848	1.00	0.97±0.03	Selvatica	0.90	1.05	0.96±0.05
Rosa di Lombardia	0.616	0.92	0.75±0.08	0.670	0.98	0.76±0.08	Cattaneo	0.70	1.25	0.98±0.09
Roumi	0.498	1.00	0.76±0.12	0.560	0.99	0.83±0.10	Kokuse	0.95	1.36	1.14±0.19
Lhu	0.352	0.74	0.57±0.10	0.510	0.80	0.68±0.06	Morettiana	0.85	1.26	1.04±0.09

tica. It was also 0.75, 0.76 and 0.57 gm. after feeding on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu respectively. The heaviest weight of female moth was that of the larva fed on the leaves of the variety Japanese L. and the minimum weight was of the larva fed on the leaves of the variety Lhu.

The average weight of female moth of the cross breed Yinhan was 0.88, 0.95, and 0.97 gm. after feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica . It was also 0.76, 0.83 and 0.68 gm. after feeding on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu respectively. The heaviest weight of moth was that of the larva fed on the leaves of the variety Japanese L. and the minimum weight was of the larva fed on the leaves of the variety Lhu.

The average weight of female moth of the race 49 M. ranged from 0.98 to 1.14 gms. with slight differences in the average weight of female moth after feeding on the leaves of different mulberry varieties.

#### *The eggs :*

The females deposit their eggs in the egg laying paper bags after mating . The eggs vary according to the different races of the silk worm , they are either adherent or not adherent. In the present studies, the eggs of the reared silk worm races were all of the adherent type.

It is clearly shown from the results of these studies that the number of the deposited eggs was affected by feeding the larvae on the leaves of different mulberry varieties.

It is evident from Table (4) that the number of eggs deposited by the female moth of the race Var was 289, 491, 300, 294, 431 and 263 after feeding on the leaves of the varieties Morettiana, Japanese L., Selvatica, Rosa di Lombardia , Roumi and Lhu respectively.

TABLE 4.

NUMBER OF EGGS DEPOSITED BY THE FEMALE MOTH OF THE RACES REARED  
IN 1959, 1960 AND 1961, AFTER FEEDING ON THE DIFFERENT  
MULBERRY LEAF VARIETIES.

Mulberry varieties	1959	1960	Mulberry varieties	1961
	N° of eggs			N° of eggs
Morettiana	289	292	Giazzola	603
Japanese L.	491	511	Florio	530
Selvatica	300	304	Selvatica	583
Rosa di Lombardia	294	485	Cattaneo	579
Roumi	434	497	Kokuso	649
Lhu	263	366	Morettiana	611

The average number of eggs deposited by the female moth of the cross breed Yinhan was 292, 511, 304, 485, 497 and 366 eggs after feeding on the leaves of the varieties Morettiana, Japanese L., Selvatica, Rosa di Lombardia, Roumi and Lhu respectively.

The average number of eggs deposited by the female moth of the race 49 M. was 603, 530, 583, 579 649 and 611 eggs after feeding on the leaves of the varieties Giazzola, Florio, Selvatica, Cattaneo, Kokuso and Morettiana respectively. The maximum numbers of egg deposited by the female moth of the races Var and Yinhan was that of the larvae fed on the leaves of the variety Japanese L. and the maximum numbers of eggs deposited by the female moth of the race 49 M. was that of the larvae fed on the leaves of the variety Kokuso. The minimum numbers of deposited eggs by the female moths of the races Var, Yinhan and 49 M. was that of the larvae fed on the leaves of the variety Lhu and Morettiana and Florio respectively.

RESUME.

EFFET D'UNE ALIMENTATION DU VER A SOIE BOMBYX MORI L. AVEC  
DIFFERENTES VARIETES DE MURIERS SUR LA FECONDITE DES  
PAPILLONS

1°) POIDS DES CHRYSALIDES : Les chrysalides des races Var et Yinhan issues de larves nourries de Japanese L. furent les plus lourdes. Pour la race 49 M. ce furent celles dont les larves avaient été nourries de Selvatica.

2°) POIDS DES PAPILLONS FEMELLES : les plus lourdes femelles furent celles élevées avec Japanese L, chez les Var et Yinhan. Pour les femelles de la race 49 M. on ne trouve pas de grande différence pondérale suivant l'alimentation.

3°) LES OEUFS : Pour les races Var et Yinhan, les papillons femelles dont les larves avaient été nourries de Japanese L. pondirent le plus grand nombre d'oeufs. Pour la race 49 M., les femelles les plus fécondes furent celles dont les larves avaient été nourries de Kokuso.

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STUDIES ON THE EFFECT OF FEEDING THE SILK WORM  
WITH DIFFERENT MULBERRY VARIETIES ON THE TECHNOLOGY  
OF THE SERIC FIBER

By M. HASSANEIN M.H.  
and EL SHAARAWY M.F. (Egypt, U.A.R.) (\*)

*INTRODUCTION*

The silk worm *Bombyx mori* L. consumes and digests the different mulberry leaf varieties, even if they vary considerably in their nutritional value.

These studies has been carried out in the Faculty of Agriculture Ain Shams University, and The Sericulture Research Section, Ministry of Agriculture, Egypt. It was also conducted in the Sericulture Research Station, Padova, Italy. These studies were conducted to select the most profitable mulberry leaf varieties to the silk worm so that it may raise the silk production in the cocoons of the different races of the silk worm.

*REVIEW OF LITERATURE*

Hiratsuka (1920), mentioned that the average quantity of silk substance secreted by 1000 worms was 240.33 gm (dry matter), which corresponded to 25 % of the dry matter digested and 65 % of the nitrogen digested in the fifth instar.

Kitazawa (1932), studied the relation between the food plants and the properties of the cocoon of

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Antheraea yamamai and Antheraea pernyi, he concluded the following result : The cocoons of both wild silk worms fed with leaves of Quercus dentata were poor in silk and it was known that the cocoons were difficultly reeled.

Malucelli (1954) , carried out nutritional tests on silk worms of various races and crosses commonly raised from reproduction and for the output of silk , taking into account also the reproductive data of various groups per gram of silk worm eggs and per commercial ounce. The results obtained had demonstrated that, even conserving unaltered the quantity of nutrient which must be given , the races actually in commerce possessed a greater capacity for utilising mulberry leaves in comparison to those of the past. The principal data of production had confirmed the visible progress achieved in the national field of silk cultivation with the employment of selected races and in particular the high degree of efficiency obtained by the races which were in white character. Their raising deserves being taken into serious consideration, with the aim also of achieving the development of types and bi-white crosses which can successfully compete with those developed by the Japanese silk industry.

#### MATERIALS

##### *Silkworm races :*

The silk worm races used in the present study were the standard breeds reared in certain Mediterranean and the far east countries of the world.

During 1959 and 1960 breeding of the silk worm was carried out in the Sericulture section, Faculty of Agriculture Ain Shams University and the Sericulture Department, Ministry of Agriculture, Egypt U.A.R. In 1961 , breeding was carried out in the Sericulture Experimental Station, Padova, Italy.

The silk worm races used in these studies were :

The race Var , considered as a local race and was reared in 1959,

The cross-breed Yinhan x Huachiu was reared in 1960.

The race 49 M. was reared in the rearing season of 1961 in Italy.

*Mulberry varieties :*

The mulberry leaves used for feeding the silk worm were :

1959 and 1960			1961		
Morus alba var.	Morettiana	Morus alba var.	Giazzola		
"	"	"	Japanese L.	"	"
"	"	"	Selvatica	"	"
"	"	"	Rosa di Lombardia	"	"
"	"	"	Roumi	"	"
"	"	"	Lhu	"	"
					Kokuso
					Morettiana

*METHODS*

*Suffocation and drying of cocoons :*

It is necessary to kill the chrysalis of the selected cocoon for the seric bave test before its transformation to the moth. The simplest and easiest manner has been found to be submission of the living cocoons to the action of heat. For this purpose desiccator was used, that comprises essentially a fan in the drying chamber in which the fresh cocoons were placed to maintain a constant air current through the mass of the chrysalides, which carries away the products formed during desiccation, humid and volatile substances and a stove for heating the air driven by the fan. Desiccation was started at a temperature of 50-60°C. and was carried to maximum of 90-95°C. After desiccation the cocoons were kept in a dry storage.

*Reeling of the seric fibers :*

The seric bave is composed of two filaments or brins which issue from the two secreteries of the worm and are struck together with sericin in the threader.

In order to examine the nature of the bave, it is unwound from the cocoon by the special apparatus which provides without occasioning any mechanical changes in it, for measuring the total length of the fiber and for some other technological properties.

The apparatus designed by Dusuzeau (1886), and modified by Verson and Quajat (1886), was used. It comprises a parallel piped in which the cocoon is placed after being softened by soaking, the water was heated by a gas jet under the container. The winder on which the bave is reeled is provided with girometer and with a guiding arm with forward and backward movement along the whole length of the winding frame allowing the seric fiber to be wound, if record is in separate skeins. Weight of the silk fiber was also determined.

Florkin and Jeuniaux (1960), studied the influence of the alimentation on the silk secretion in the light of the knowledge on the origin and the part of the amino acids in the haemolymph. They stated that the quality and the quantity of the food taken by the silk worm during the periods of tissues growth, the period of "facultative" alimentation, in the middle of the fifth instar, had an important indirect repercussion on the quantity of the silk which was spun.

#### *RESULTS AND DISCUSSION*

##### *The seric bave :*

The seric bave is composed of two brinds united together by sericin. With the exception of the first layers, which constituted the crust or husk of the cocoon the seric bave is deposited in the cocoon with a certain regularity in the form of loops or eyelets.

In order to examine the nature of the bave it is reeled from the cocoon by a special apparatus for measuring the total length of the seric filament and for cutting it into any special lengths for special tests.

*Length and weight of the seric fiber :*

For measuring the length of the seric fiber, cocoons of the different breeds after feeding on the leaves of different mulberry varieties are reeled and their lengths and weights are recorded in Tables (1 - 9) and graphically illustrated in Figs (1, 2 and 3).

It is shown from Table (1) and Fig. (1) that the average length of silk in the cocoon of the race Var after feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica was 569.0, 554.7 and 441.1 meters respectively. It was also 569.1, 486.2 and 358.3 meters by feeding on the leaves of the varieties Rosa di lombardia, Roumi and Lhu.

The maximum length of silk in the cocoon was of the larva fed on the leaves of the varieties Rosa di lombardia and Morettiana without any differences between them, and the minimum length of silk in the cocoon was of the larva fed on the leaves of the variety Lhu.

The average weight of silk was 0.122 , 0.145 and 0.115 gm. by feeding the worms on the leaves of the varieties Morettiana, Japanese L. and Selvatica. It was also 0.130, 0.104 and 0.187 gm. by feeding the larvae on the leaves of the varieties Rosa di lombardia, Roumi and Lhu respectively. The heaviest weight of silk was in the cocoon of the larva fed on the leaves of the variety Lhu , and the minimum weight was produced from the cocoons of larva fed on the leaves of the variety Roumi.

The average thickness of the seric fiber is also recorded in Table (1) and Fig. (1). It was 1.92 2.30 and 2.33 denier by feeding the worms on the leaves of the varieties Morettiana , Japanese L. and Selvatica. It was also 2.03 , 1.93 and 4.68 denier after feeding on the leaves of the varieties Rosa di lombardia , Roumi and Lhu respectively . The maximum thickness of the seric fiber was by feeding the worms on the laaves of the variety Lhu and, the minimum thickness was by feeding the larvae on the leaves of the varieties Morettiana and Roumi.

TABLE 1.

AVERAGE LENGTH, WEIGHT AND THICKNESS OF THE SERIC FIBER OF THE RACE VAR, AFTER FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Mulberry variety	Length of silk (meter)			Weight of silk (per gram)			Denier
	Min.	Max.	Mean	Min.	Max.	Mean	
(1959)							
Morettiana	290	755	569.0	0.040	0.200	0.122	1.92
Japanese L.	280	765	554.7	0.074	0.220	0.145	2.30
Seivatica	240	670	441.1	0.040	0.200	0.115	2.33
Rosa di Lombardia	400	725	569.1	0.040	0.190	0.130	2.03
Roumi	290	795	486.2	0.040	0.170	0.104	1.93
Lhu	260	540	358.3	0.064	0.240	0.187	4.68

TABLE 2.

ANALYSIS OF VARIANCE REGARDING LENGTH OF SILK IN THE COCOONS OF THE RACE VAR. AND FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES.  
(1959)

Source of variation	D.F.	Total S. square	Mean S. square	F.
Varieties	5	1806131	3612262	27.3 **
Error	294	3892394	132411	
Total	299	5699025		

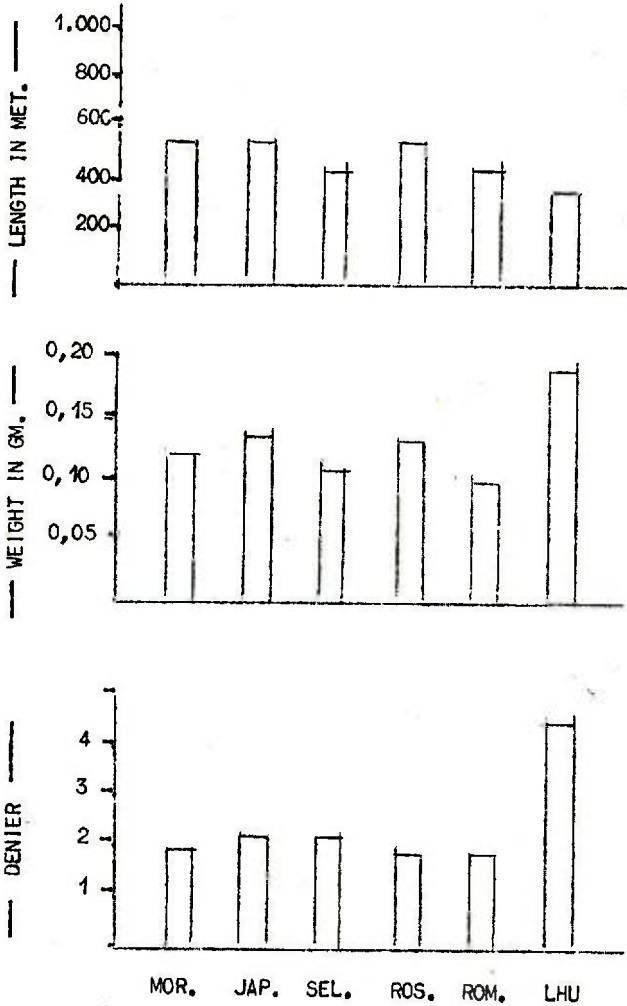
TABLE 3.

ANALYSIS OF VARIANCE REGARDING WEIGHT OF SILK IN THE COCOONS OF THE RACE VAR. AND FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Source of variation	D.F.	Total S. square	Mean S. square	F.
Varieties	5	0.22	0.044	33.8 **
Error	294	0.40	0.0013	
Total	299	0.62		

\*\* Significant at the level 0.01

- 1959 -



Tables (2 and 3) show that there was a highly significant difference in the average length and weight of the seric fiber in the cocoon of the race Var after feeding on the leaves of different mulberry varieties.

The average length of silk in the cocoon of the cross breed Yinhan is recorded in Table (4) and illustrated in Fig. (2). It was 672, 726 and 644 meters after feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica. It was also 773, 738 and 572 meters after feeding on the leaves of the varieties Rosa di lombardia, Roumi and Lhu respectively. The maximum length of silk was in the cocoon of the larva fed on the leaves of the variety Rosa di lombardia, and the minimum length of silk was in the cocoon of the larva fed on the leaves of the variety Lhu.

The average weight of silk is clearly shown in Table (4) and Fig. (2). It was 0.184, 0.108 and 0.184 gm. after feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica. It was also 0.163, 0.187 and 0.139 gm. after feeding on the leaves of the varieties Rosa di lombardia, Roumi and Lhu respectively. The heaviest weight of silk was in the cocoon of the larva fed on the leaves of the variety Roumi, and the minimum weight of silk was in the cocoon of the larva fed on the leaves of the variety Japanese L.

The average thickness of the seric fiber was 2.46, 2.57 and 2.57 denier after feeding the worms on the leaves of the varieties Morettiana, Japanese L. and Selvatica. It was also 1.90, 2.38 and 2.18 denier after feeding the worms on the leaves of the varieties Rosa di lombardia, Roumi and Lhu respectively. The maximum thickness of the seric fiber was excreted from the larva fed on the leaves of the varieties Japanese L. and Selvatica. The minimum thickness was in the seric fiber secreted from the larva fed on the leaves of the variety Rosa di lombardia.

Tables (5 and 6) clearly show that there was a highly significant difference in the average length and weight of the seric fiber after feeding the worms on the leaves of the different mulberry varieties.

TABLE 4.

AVERAGE LENGTH, WEIGHT AND THICKNESS OF THE SERIC FIBER OF THE RACE YINHAN, AFTER FEEDING THE LARVAE ON THE DIFFERENT LEAF MULBERRY VARIETIES

Mulberry variety	Length of silk (meter)			Weight of silk (per gram)			Denier
	Min.	Max.	Mean	Min.	Max.	Mean	
	(1960)						
Morettiana	360	895	672	0.090	0.310	0.164	2.46
Japanese L.	330	990	726	0.080	0.294	0.208	2.57
Selvatica	415	865	644	0.080	0.282	0.184	2.57
Rosa di Lombardia	330	1190	773	0.050	0.250	0.163	1.90
Roumi	380	735	738	0.064	0.240	0.187	2.38
Lhu	340	900	572	0.040	0.240	0.139	2.18

TABLE 5.

ANALYSIS OF VARIANCE REGARDING LENGTH OF SILK IN THE COCOONS OF THE RACE YINHAN AND FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Source of variation	D.F.	Total S. square	Mean S. square	F.
Varieties	5	1123256	222651.2	
Error	294	4479874	15237.1	14.6 **
Total	299	5603127		

TABLE 6.

ANALYSIS OF VARIANCE REGARDING WEIGHT OF SILK IN THE COCOONS OF THE RACE YINHAN AND FEEDING IN OTHER DIFFERENT MULBERRY LEAF VARIETIES.

Source of variation	D.F.	Total S. square	Mean S. square	F.
Varieties	5	0.10	0.02	
Error	294	0.66	0.0002	100.0 ***
Total	299	0.76		

\*\*\* Significant at the level 0.01

- 1960 -

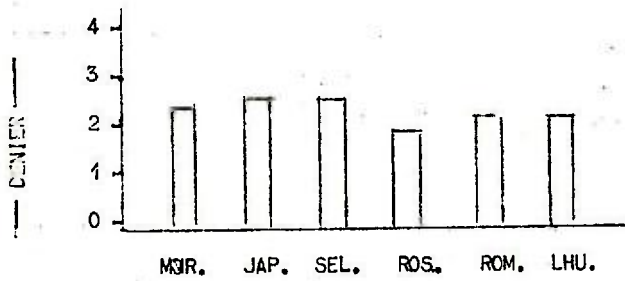
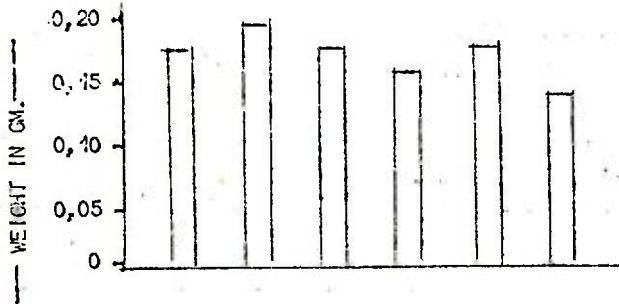
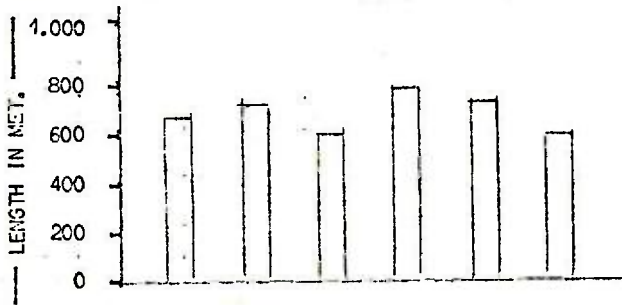


TABLE 7.

AVERAGE LENGTH, WEIGHT AND THICKNESS OF THE SERIC FIBER OF THE RACE 49M. , AFTER FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES.

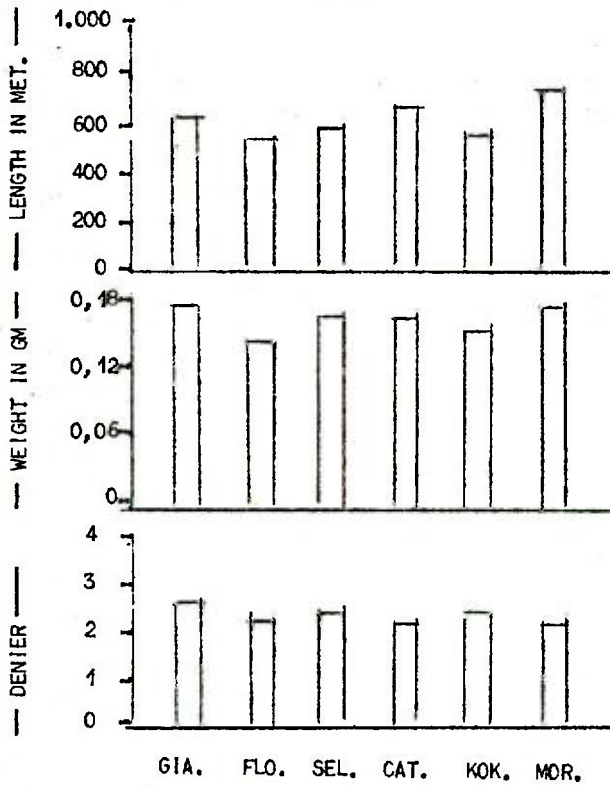
Mulberry variety	Length of silk (meters)			Weight of silk (per gram)			Denier
	Min.	Max.	Mean	Min.	Max.	Mean	
			(1964)				
Giazzola	421	936	633.9	0.093	0.266	0.177	2.51
Florio	339	795	555.9	0.081	0.195	0.140	2.27
Selvatica	400	808	612.4	0.095	0.220	0.160	2.34
Cattaneo	424	908	671.6	0.108	0.208	0.162	2.16
Kokuso	429	791	583.2	0.107	0.206	0.151	2.32
Morettiana	552	991	733.0	0.112	0.225	0.171	2.10

Table (7) and Fig. (3) represent the average length of silk reeled from the cocoon of the race 49 M. after feeding the worms on the leaves of different mulberry varieties. It was 633.9 , 555.9 and 612.4 meters by feeding the worms on the leaves of the varieties Giazzola, Florio and Selvatica. It was also 677.6, 583.2 and 733.0 meters by feeding the larvae on the leaves of the varieties Cattaneo, Kokuso and Morettiana respectively. The maximum length of silk was obtained from the larvae fed on the leaves of the variety Morettiana , and the minimum length of silk was excreted from the larva fed on the leaves of the variety Florio.

The average weight of silk is recorded in Table (7) and graphically illustrated in Fig. (3). It was 0.177 , 0.140 and 0.160 gm. after feeding the worms on the leaves of the varieties Giazzola, Florio and Selvatica . It was also 0.162, 0.151 and 0.171 gm. by feeding the larvae on the leaves of the varieties Cattaneo, Kokuso and Morettiana. The maximum weight of silk was excreted from the larva fed on the leaves of the variety Giazzola, and the minimum weight of silk was excreted from the larva fed on the leaves of the variety Florio.

The average thickness of the seric fiber was 2.51, 2.27 and 2.34 denier after feeding on the lea-

- 1961 -



ves of the varieties Giazzola, Florio and Selvatica. It was also 2.16, 2.32 and 2.10 denier by feeding on the leaves of the varieties Cattaneo, Kokuso and Morettiana respectively. The maximum thickness of the seric fiber was of the silk secreted from the larva fed on the leaves of the variety Giazzola, and the minimum thickness was of the larva fed on the leaves of the variety Morettiana.

It is evident from Tables (8 and 9) that there was a highly significant difference in the average length and weight of silk secreted from the larvae fed on the leaves of the different mulberry varieties. The different mulberry leaf varieties were classified according to their nutritional value on the characters of silk length and silk weight during the three experimental years is clearly shown in Table (10).

TABLE 8.

ANALYSIS OF VARIANCE REGARDING LENGTH OF SILK IN THE COCOONS OF THE RACE 49 M. AND FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES

Source of variation	D.F.	Total S. square	Mean S. square	F.
Varieties	5	108752403	2175040.6	186.6 **
Error	294	3422350	11641.1	
Total	299	112174753		

TABLE 9.

ANALYSIS OF VARIANCE REGARDING WEIGHT OF SILK IN THE COCOONS OF THE RACE 49 M. AND FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES

Variations	D.F.	Total S. square	Mean S. square	F.
Varieties	5	0.04	0.008	80 **
Error	294	0.04	0.0001	
Total	299	0.08		

\*\* Significant at the level 0.01

TABLE 10.

MULBERRY VARIETIES CLASSIFIED ACCORDING TO ORDER OF MERITS

	Length of silk		
	1959	1960	1961
1 Rosa di Lombardia	Rosa di Lombardia	Morettiana	
2 Morettiana	Roumi	Cattaneo	
3 Japanese	Japanese	Giazzola	
4 Roumi	Morettiana	Selvatica	
5 Selvatica	Selvatica	Kokuso	
6 Lhu	Lhu	Florio	
	Weight of silk		
1 Lhu	Japanese	Giazzola	
2 Japanese L.	Roumi	Morettiana	
3 Rosa di Lombardia	Morettiana	Cattaneo	
4 Morettiana	Selvatica	Selvatica	
5 Selvatica	Rosa di Lombardia	Kokuso	
6 Roumi	Lhu	Florio	

RESUME

EFFET DE L'ALIMENTATION DU VER A SOIE SUR LA TECHNOLOGIE DE LA FIBRE

Plusieurs races de ver à soie furent nourries de différentes variétés de mûrier. La longueur des brins et le poids de la soie furent ensuite mesurés en vue d'accroître la production de la soie dans la République Arabe Unie.

Il ressort de cette étude qu'il y a des différences significatives dans les longueurs moyennes et les poids moyens de la fibre de soie des différentes races dont les larves ont été alimentées avec des variétés différentes de mûrier.

Les larves Var et Yinhan qui produisirent le brin le plus long au titre le plus élevé furent celles nourries de Rosa di Lombardia. Pour les larves 49 M ce furent celles élevées avec du Morettiana.

Chez les Var nourris de Lhou les cocons furent les plus riches en soie ; chez les Yinhan nourris de Japanese L. les cocons furent les plus riches en soie. Pour les 49 M les cocons les plus riches en soie furent ceux des larves nourries de Giazzola.

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STUDIES ON THE EFFECT OF FEEDING DIFFERENT RACES  
OF THE SILK WORM WITH CERTAIN MULBERRY VARIETIES ON  
THE SILK GLANDS AND COCOON CHARACTERS

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INTRODUCTION

The mulberry leaves differs so greatly in their nutritional value to the silk worm *Bombyx mori* L.

This work has been carried out in the Faculty of Agriculture, Ain Shams University, and the Sericulture Research Dept., Ministry of Agriculture, it was also conducted in the Sericulture Research Station, Padova, Italy.

These studies were carried out to study the effect of feeding different races of the silk worm with certain mulberry varieties on the silk glands and the cocoon characters.

REVIEW OF LITERATURE

Bounhiol (1950), carried out studies on the growth in length of silk worms fed on mulberry and silk worms fed on *Succedanea*. He stated that the length of silk worms exclusively fed from hatching on *Xylosoma* or on *Scorzzanera* differed only by details (faster growth in length at the beginning of the larval life, greater retraction when moulting)

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from that of silk worms fed on mulberry at the same time. The final size reached and the general shape of diagrams were the same.

Fraisse (1952), carried out experiments on feeding, growth, cocoon and silk of *Bombyx mori* L., on the chemical and physical variations of *Morus alba colombassa* L. leaves. During all the time of growth of mulberry, leaves were taken of different parts for comparing them under their physical and chemical conditions and for studying their value for the silk worm rearing. It was noted that :

1 - From the fourth to the eighth hour, the rapidity of evaporation of leaves which have been taken down was the greatest. At the beginning of the growth this evaporation rapidity was greater in the young leaves than the old leaves. With advancing of the season the order was reversed.

2 - The top leaves have a thinner limb than the bottom ones (120-170 $\mu$  to 150-190 $\mu$ ).

3 - On an equal surface an apical leaf was always lighter than the basal leaves, (12-17mgm to 15-19mgm per cm<sup>2</sup>).

4 - In the young leaves the limb density seemed to reach its maximum value at the beginning of the growth; it decreased afterwards.

5 - In the course of the growth time of the mulberry, it was noted in the leaves an important decrease in the relative content of water, total nitrogen, albuminoid nitrogen, soluble nitrogen, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and it was noted an increase in CaO and MgO.

6 - The ratio between the content of albuminoid and total nitrogen raised very little with the increase of the leaf age (0.75 - 0.85).

7 - On the contrary the ratios of P<sub>2</sub>O<sub>5</sub>/total nitrogen, P<sub>2</sub>O<sub>5</sub>/CaO, (total N + P<sub>2</sub>O<sub>5</sub>/CaO decrease very quickly with the leaf development).

a) P<sub>2</sub>O<sub>5</sub>/total N (0.34-0.12).

b) P<sub>2</sub>O<sub>5</sub>/CaO (1.29-0.03).

c) Total N + P<sub>2</sub>O<sub>5</sub>/CaO (5.37-0.26).

Fraisse and Arnoux (1954), carried out studies upon the effect of feeding on the biometrics of the silk worm cocoons, he stated that :

1 - The average values of each of the following characters regularly decreased as the mulberry leaf eaten by the silk worms was near to the ripeness : weight, dimensions, surface and volume of the cocoon , weight of exuvia, pupa weight , weight and thickness of the shell.

2 - Cocoons of the four moults worms were heavier and bigger than those of the five moults worms.

3 - Decrease of the silk richness of the cocoons of the late rearings.

#### MATERIALS

*Silk worm races :*

The silk worm races used in the present study were the standard breeds reared in certain Mediterranean and the far east countries of the world.

During 1959 and 1960 breeding of the silk worm was carried out in the Sericulture section, Faculty of Agriculture Ain Shams University and the Sericulture Department , Ministry of Agriculture , Egypt, U.A.R. In 1961, breeding was carried out in the Sericulture Experimental Station, Padova, Italy.

The silk worm races used in these studies were

The race Var, considered as a local race and was reared in 1959.

The cross - breed Yinhan x Huachiu was reared in 1960.

The race 49 M. was reared in the rearing season of 1961 in Italy.

*Mulberry varieties*

The mulberry leaves used for feeding the silk worm were :

1959 - 1960				1961			
Morus	alba	var.	Morettiana	Morus	alba	var.	Giazzola
"	"	"	Japanese L.	"	"	"	Florio
"	"	"	Selvatica	"	"	"	Selvatica
"	"	Rosa di	Lombardia	"	"	"	Cattaneo
"	"	"	Roumi	"	"	"	Kokuso
"	"	"	Lhu	"	"	"	Morettiana

*METHODS*

*Suffocation and drying of cocoons :*

It is necessary to kill the chrysalis of the selected cocoon for the seric bave test before its transformation to the moth. The simplest and easiest manner has been found to be submission of the living cocoons to the action of heat. For this purpose desiccator was used, that comprises essentially a fan in the drying chamber in which the fresh cocoons were placed to maintain a constant air current through the mass of the chrysalidas, which carries away the products formed during desiccation, humid and volatile substances and a stove for heating the air driven by the fan. Desiccation was started at a temperature of 50-60°C. and was carried to a maximum of 90-95°C. After desiccation the cocoons were kept in a dry storage. Length, width, fresh weight and dry weight of the cocoons were ascertained.

*RESULTS AND DISCUSSION*

*The silk gland :*

The silk worm has two serific glands or seric tries. They have three distinct parts - posterior, medium and anterior -- known respectively as the secretory canal, the reservoir and the excretory canal. Each secretory canal starts as elongated cylin-

dricul, convoluted tube whose posterior free end is blind. This tube runs cephalade dorsally alongside the alimentary canal from about the seventh segment up to the second. At this point the tube swells out forming a silk reservoir, which extends ventro-latero to the alimentary canal and runs forward for a short distance, then it blends and proceeds backwards again down to the sixth abdominal segment where it runs cephalade for the second time until it reaches the hind margin of the metathorax, the silk reservoir turns mesally and gradually narrows. In the metathorax, the narrow anterior end of the reservoir proceeds forwards as an excretory canal. The two excretory canals traverse the thoracic segments alongside the ventral nerve cord, converging as they proceed forwards, they pass through the head until they reach the suboesophageal ganglion, beneath which they run side by side. They proceed forwards as such along the medio-ventral line of the body until just before the organ known as the silk press (spinneret) there they unit with each other forming a very short common duct that opens into the base of the silk press. From the silk press extends anteriorly a narrow terminal duct that opens at the tip of the spinneret. Located inside the prèmentum is a pair of proportionately large voluminous glands, the accessory (or Fillipp's) glands. Each accessory gland opens separately by means of short duct into the silk duct of its side just before the beginning of the common silk duct.

In Table (1) the data obtained clearly illustrated the weights of the reservoir of the silk gland in the mature larva after feeding on the leaves of the different mulberry varieties.

The average weight of the silk gland reservoir of the race Var which was reared in 1959 was 0.245, 0.228 and 0.196 gm. after feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica, and it was 0.153, 0.163 and 0.086 gm, after feeding on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu respectively.

It can be concluded from the comparison of the results that the average weight of the silk gland

TABLE 1.

MEAN WEIGHT OF THE SILK GLAND RESERVOIR PER GM. IN THE MATURE LARVA,  
AFTER FEEDING ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Mulberry varieties	Var (1959)			Yinhan (1960)			Mulberry varieties	49 M (1961)		
	Min.	Max.	Mean+S.D.	Min.	Max.	Mean+S.D.		Min.	Max.	Mean+S.D.
Morettiana	0.172	0.308	0.245+0.066	0.286	0.384	0.340+0.026	Giazzola	0.493	0.821	0.505+0.011
Japanese L.	0.155	0.324	0.228+0.066	0.258	0.374	0.330+0.035	Flori	0.399	0.593	0.468+0.006
Selvatica	0.179	0.242	0.196+0.013	0.287	0.402	0.334+0.031	Selvatica	0.289	0.632	0.499+0.010
Rosa di Lombardia	0.112	0.232	0.153+0.035	0.190	0.318	0.237+0.033	Gattaneo	0.437	0.666	0.528+0.006
Roumi	0.086	0.244	0.163+0.026	0.146	0.246	0.213+0.028	Kokuso	0.436	0.708	0.597+0.008
Lhu	0.064	0.142	0.086+0.024	0.084	0.152	0.113+0.018	Morettiana	0.484	0.792	0.597+0.008

reservoir of the larva fed on the leaves of the variety Morettiana was heavier than the other varieties, and the minimum weight was that of the worms fed on the leaves of the variety Lhu.

The average weight of silk gland reservoir in the mature larva of the cross breed Yinhan was , 0.340 , 0.350 and 0.334 gm. after feeding the larva on the leaves of the varieties Morettiana, Japanese L. and Selvatica, and it was 0.237, 0.213 and 0.113 gm. after feeding on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu, respectively. The heavier weight was that of the larva fed on the leaves of the variety Morettiana, and the minimum weight was of the larva fed on the leaves of the variety Lhu. The average weight of the silk gland reservoir of the race 49 M. is clearly shown in Table (51) and it was 0.605 , 0.468 and 0.499 gm. after feeding the larva on the leaves of the varieties Giazzola , Florio and Selvatica. It was also 0.528, 0.587 and 0.597 gm. after feeding the larva on the leaves of the varieties Cattenea, Kokuso, and Morettiana respectively . The maximum weight of the silk gland reservoir , was that of the larva fed on the leaves of the variety Giazzola , and the minimum weight was of the larva fed on the leaves of the variety Florio.

#### *Shape of cocoon :*

The common shape of the Bombyx mori L. cocoons are spherical, oval and waisted. The cocoons of the cross breed Yinhan and 49 M. was of the oval type and the cocoons of the race Var was of the waisted type.

The length and width of the cocoon varies in the different races and it is shown from Tables (56, 57 and 58) that there was a slight differences in the dimensions of the cocoon after feeding on different mulberry leaf varieties.

The average length of cocoon of the race Var ranged from 2.96 to 3.07 cms and the maximum length of cocoon was that of the worms fed on the leaves of the variety Morettiana , and the minimum length of

TABLE 2.

LENGTH AND WIDTH OF THE COCOON PER CMS OF THE RACE VAR, AFTER FEEDING THE LARVA ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Mulberry variety	Length of cocoon			Width of cocoon		
	Min.	Max.	Mean	Min.	Max.	Mean
(1959)						
Morettiana	2.6	3.5	3.07	1.6	1.9	1.77
Japanese L.	2.7	3.4	3.05	1.6	1.9	1.76
Selvatica	2.6	3.5	2.99	1.6	1.9	1.79
Rosa di Lombardia	2.6	3.5	2.92	1.5	1.9	1.75
Roumi	2.6	3.7	2.96	1.4	1.9	1.75
Lhu	2.6	3.2	2.98	1.7	1.9	1.75

TABLE 3.

LENGTH AND WIDTH OF THE COCOON PER CMS OF THE RACE YINHAN, AFTER FEEDING THE LARVA ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Mulberry variety	Length of cocoon			Width of cocoon		
	Min.	Max.	Mean	Min.	Max.	Mean
(1960)						
Morettiana	2.6	3.9	3.40	1.6	1.9	1.75
Japanese L.	2.3	3.9	3.23	1.4	1.9	1.71
Selvatica	2.6	3.6	3.01	1.6	1.9	1.76
Rosa di Lombardia	2.8	3.9	3.11	1.5	1.9	1.70
Roumi	2.6	3.7	3.27	1.5	1.9	1.62
Lhu	2.8	3.6	3.17	1.5	1.9	1.77

TABLE 4.

LENGTH AND WIDTH OF THE COCOON PER ONE OF THE RACE 49 M., AFTER FEEDING THE LARVA ON THE DIFFERENT MULBERRY LEAF VARIETIES.

	Length of cocoon			Width of cocoon		
	Min.	Max.	Mean	Min.	Max.	Mean
(1961)						
Giazzola	3.05	4.05	3.47	1.50	1.70	1.71
Florio	2.95	3.62	3.27	1.45	1.96	1.61
Selvatica	3.00	3.74	3.39	1.38	1.90	1.63
Cattaneo	3.00	3.84	3.33	1.45	1.87	1.65
Kokuso	3.00	3.85	3.37	1.45	1.95	1.66
Morettiana	2.94	3.65	3.24	1.40	1.80	1.58

cocoon was of the worms fed on the leaves of the variety Roumi.

The average length of cocoon was 1.7 cms with a very slight differences after feeding on the leaves of different mulberry varieties.

Length of cocoon of the breed Yinhan ranged from 3.01 to 3.23 cms. The maximum length of cocoon was that of the larva fed on the leaves of the variety Japanese L. and the minimum length of cocoon was of the larva fed on the leaves of the variety Selvatica. There was also a slight differences in the average width of cocoon after feeding on the leaves of different mulberry varieties.

Length of cocoon of the race 49 M. ranged from 3.24 to 3.47 cms after feeding on the leaves of the different mulberry varieties. The maximum length of cocoon was that of the larva fed on the leaves of the variety Giazzola and the minimum length of cocoon was of the larva fed on the leaves of the variety Morettiana. The width of cocoon varied from 1.58 to 1.71 cms. The maximum width of cocoon was that of the larva fed on the leaves of the variety Giazzola, and the minimum width of cocoon was of the larva fed on the leaves of the variety Morettiana.

*Weight of cocoon :*

The cocoons show continuous loss of weight from the time of its completion until the maturity of the moth, due to the respiration of the chrysalis and simple evaporation. This loss of weight may be considerable. In the process of desiccation, the weight of the cocoon is reduced by about two thirds, mainly by elimination of water.

The average weight of the cocoon varies according to racial and nutritional conditions. Cocoons were separately weighted to determine their maximum, minimum and average weight. Statistical analysis of the standard deviation and coefficient of variation were also recorded.

Tables (5, 6 and 7) and Fig. (1) indicate the minimum, maximum and average weight of fresh and dry

TABLE 5.

AVERAGE FRESH AND DRY WEIGHT OF COCOON OF THE RACE VAR PER GM.  
AFTER FEEDING THE LARVA ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Mulberry variety	Fresh weight of cocoon per gram			Dry weight of cocoon per gram		
	Min.	Max.	Mean±S.D.	Min.	Max.	Mean±S.D.
(1959)						
Morettiana	1.50	2.20	1.756±0.074	0.971	0.629	0.556±0.041
Japanese L.	1.50	1.87	1.652±0.114	0.480	0.757	0.625±0.061
Selvatica	1.36	1.87	1.602±0.117	0.515	0.615	0.572±0.030
Rosa di Lombardia	1.31	1.58	1.927±0.083	0.425	0.543	0.479±0.031
Roumi	1.21	1.67	1.419±0.041	0.431	0.529	0.475±0.034
Lhu	1.13	1.75	1.306±0.162	0.310	0.500	0.401±0.042

TABLE 6.

AVERAGE FRESH AND DRY WEIGHT OF COCOON OF THE RACE YINHAN PER GM., AFTER FEEDING THE LARVA ON THE DIFFERENT MULBERRY LEAF VARIETIES

Mulberry variety	Fresh weight of cocoon per gram			Dry weight of cocoon per gram		
	Min.	Max.	Mean±S.D.	Min.	Max.	Mean±S.D.
(1960)						
Morettiana	1.44	1.70	1.536±0.077	0.540	0.640	0.594±0.030
Japanese L.	1.50	1.79	1.566±0.078	0.578	0.638	0.609±0.017
Selvatica	1.34	1.79	1.529±0.122	0.533	0.625	0.574±0.024
Rosa di Lombardia	1.25	1.50	1.348±0.073	0.400	0.557	0.502±0.036
Roumi	1.21	1.37	1.296±0.046	0.444	0.544	0.494±0.028
Lhu	1.04	1.26	1.144±0.059	0.409	0.467	0.448±0.041

TABLE 7.

AVERAGE FRESH AND DRY WEIGHT OF COCOON OF THE RACE 49 R. PER GM., AFTER FEEDING THE LARVA ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Mulberry variety	Fresh weight of cocoon per gram			Dry weight of cocoon per gram		
	Min.	Max.	Mean±S.D.	Min.	Max.	Mean±S.D.
Glazzola	1.31	2.36	1.73±0.30	0.398	1.294	0.672±0.173
Florio	1.00	2.03	1.47±0.21	0.353	0.717	0.515±0.081
Selvatica	1.07	2.30	1.59±0.24	0.434	0.747	0.554±0.083
Cattaneo	1.10	2.05	1.54±0.23	0.341	0.613	0.509±0.083
Kokuso	1.20	2.54	1.71±0.29	0.400	0.846	0.614±0.105
Morettiana	1.25	2.20	1.68±0.22	0.412	0.812	0.679±0.089

weight of the cocoon in the different races after feeding on the leaves of different mulberry varieties. In 1959 where the race Var was reared, the average fresh weight of cocoon was 1.756, 1.652 and 1.602 gms after feeding the larvae on the leaves of the varieties Morettiana, Japanese L. and Selvatica. It was also 1.427, 1.419 and 1.306 gms by feeding the worms on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu respectively. The heaviest weights of the cocoon was that of the larva fed on the leaves of the variety Morettiana, and the minimum weight of cocoon was that of the larva fed on the leaves of the variety Lhu.

The average dry weight of cocoon of the same race was 0.556, 0.625 and 0.572 gms after feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica. The dry weight of cocoon was also 0.479, 0.475 and 0.401 gms by feeding the worms on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu respectively. The maximum dry weight of the cocoon was that of the worms fed on the leaves of the variety Japanese L. and the minimum weight Lhu.

It is also clearly shown from Table (62) that there is a highly significant difference in the average dry weight of cocoons according to the feeding of the worms on the leaves of the different mulberry varieties.

Table (6) and Fig. (1) represent the average fresh weight of the cocoon of the cross breed Yinhan after feeding on the different mulberry varieties. The average weight of the cocoon was 1.536, 1.566 and 1.529 gms after feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica. It was also 1.348, 1.296 and 1.144 gms after feeding on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu respectively.

The maximum weight of the cocoon was that of the larvae fed on the leaves of the variety Japanese L. and the minimum weight of the cocoon was of the worms fed on the leaves of the variety Lhu.

It is also clearly shown from Table (62) that there is a highly significant difference in the average dry weight of cocoons according to the feeding of the worms on the leaves of the different mulberry varieties.

Table (6) and Fig. (1) represent the average fresh weight of the cocoon of the cross breed Yinhan after feeding on the different mulberry varieties. The average weight of the cocoon was 1.536, 1.566 and 1.529 gms after feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica. It was also 1.348, 1.296 and 1.144 gms after feeding on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu respectively.

The maximum weight of the cocoon was that of the larvae fed on the leaves of the variety Japanese L. and the minimum weight of the cocoon was of the worms fed on the leaves of the variety Lhu.

The average dry weight of the cocoon of the same race was 0.594, 0.609 and 0.574 gms after feeding on the leaves of the varieties Morettiana, Japanese and Selvatica. It was also 0.502, 0.494 and 0.448 gms after feeding the worms on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu respectively.

The heaviest weight of cocoon was in accordance with the average dry weight of cocoon of the race Var.

Analysis of variance regarding the effect of nutrition with the leaves of different mulberry varieties on the average dry weight of cocoon is shown in Table (8) which proved that there was a highly significant difference in the average dry weight of cocoon after feeding on the leaves of the different mulberry varieties.

Table (8) and Fig. (1) represent the average fresh weight of the cocoon of the race 49 M. It was 1.73, 1.47 and 1.59 gms after feeding on the leaves of the varieties Giazzola, Florio, and Selvatica. It was also 1.54, 1.71 and 1.68 gms by feeding on the leaves of the varieties Cattaneo, Kokuso and Morettiana respectively. The heaviest weight of fresh co-

TABLE 8.

ANALYSIS OF VARIANCE, REGARDING DRY WEIGHT OF THE COCOONS OF DIFFERENT RACES AND FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Source of variation	D.F.	Total S. square	Mean S. square	F.
<u>A. Race Var (1959)</u>				
varieties	5	0.49	0.098	51.6**
Error	84	0.16	0.0019	
Total	89	0.65		
<u>B. Race Yinhan (1960)</u>				
varieties	5	0.31	0.062	74.5**
Error	84	0.07	0.0008	
Total	89	0.38		
<u>C. Race 49 M. (1961)</u>				
varieties	5	1.43	0.286	953.0***
Error	294	0.09	0.0003	
Total	299	1.52		

\*\*\* Significant at the level 0.01

coon was of the larva fed on the leaves of the variety Giazzola, and the minimum weight of the cocoon was of the larva fed on the leaves of the variety Florio.

The average dry weight of the cocoon of the same race was 0.672, 0.505 and 0.554 gms after feeding on the leaves of the varieties Giazzola, Florio and Selvatica. It was also 0.509, 0.614 and 0.679 gms after feeding on the leaves of the varieties Cattaneo, Kokuso and Morettiana. The heaviest weight of cocoon was of the larva fed on the leaves of the variety Morettiana, and the minimum weight of the cocoon was of the larva fed on the leaves of the variety Cattaneo. Table 62 shows also that there was a highly significant difference in the average dry weight of the cocoon after feeding the larvae on the leaves of the different mulberry varieties.

TABLE 10.

AVERAGE WEIGHT OF COCOON CORTEX PER GM. AFTER FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES.

Mulberry variety	1959			1960		
	Min.	Max.	Mean±S.D.	Min.	Max.	Mean±S.D.
Morettiana	0.180	0.270	0.237±0.023	0.250	0.360	0.314±0.030
Japanese L.	0.230	0.330	0.261±0.034	0.250	0.430	0.348±0.045
Selvatica	0.200	0.270	0.225±0.024	0.240	0.400	0.309±0.050
Rosa di Lombardia	0.150	0.230	0.191±0.030	0.200	0.320	0.273±0.030
Roumi	0.180	0.260	0.217±0.024	0.200	0.310	0.262±0.031
Lhu	0.100	0.250	0.185±0.045	0.160	0.250	0.208±0.024

*Weight of cocoon cortex :*

Table (10) and Fig. (1) reflect the average weight of cocoon cortex of the race Var reared in 1959 by feeding the worms on the leaves of different mulberry varieties. The average weight of cortex was 0.237, 0.261 and 0.225 gms by feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica. It was also 0.191, 0.217 and 0.185 gms by feeding the worms on the leaves of the varieties Rosa di Lombardia, Roumi and Lhu respectively. The heaviest weight of cortex was of the larva fed on the leaves of the variety Japanese L. and the least weight of cortex was of the larva fed on the leaves of the variety Lhu.

The average weight of cortex of the cross breed Yinhan reared in 1960 is shown in Table (63), it was 0.314, 0.348 and 0.309 gm by feeding on the leaves of the varieties Morettiana, Japanese L. and Selvatica. It was also 0.273, 0.262 and 0.208 gm. by feeding on the leaves of the varieties Rosa di Lombardia, Roumi, and Lhu respectively. The minimum and maximum weight of cocoon cortex was in accordance with those reared in 1959.

TABLE 11.

AVERAGE WEIGHT OF COCOON CORTEX PER GM., AFTER FEEDING THE LARVAE ON THE DIFFERENT MULBERRY LEAF VARIETIES

Mulberry variety	Weight of Cortex		
	Min.	Max.	Mean±S.D.
	(1961)		
Glazzola	0.164	0.313	0.245+0.030
Florio	0.156	0.253	0.199+0.053
Selvatica	0.151	0.272	0.216+0.028
Cattaneo	0.130	0.264	0.212+0.030
Kokuso	0.191	0.282	0.204+0.031
Morettiana	0.138	0.275	0.194+0.040

Table (11) and Fig. (1) illustrate the average dry weight of cocoon cortex of the race 49 M. reared in 1961, as it was 0.245, 0.199 and 0.216 gm by feeding on the leaves of the varieties Glazzola Florio and Selvatica. It was also 0.212, 0.204 and 0.194 gm. by feeding on the leaves of the varieties Cattaneo, Kokuso and Morettiana respectively.

The heaviest weight of the cortex was of the larva fed on the leaves of the variety Glazzola and the least weight was of the larva fed on the leaves of the variety Morettiana.

Table (12 a, b, and c) showed that there was a highly significant difference in the average weight of cocoon cortex after feeding on the leaves of different mulberry varieties.

The different mulberry varieties were classified according to the average weight of cocoon cortex of the different races of the silk worm *Bombyx mori* L. in Table (13).

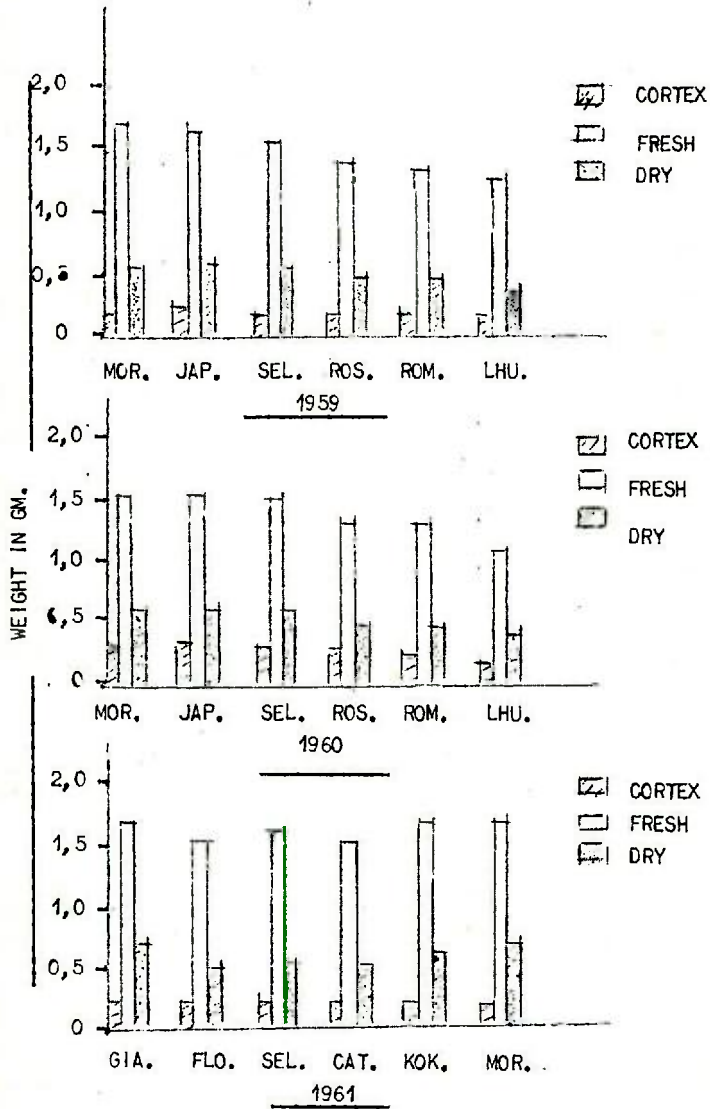


TABLE 12.

ANALYSIS OF VARIANCE REGARDING WEIGHT OF COCOON CORTEX AND  
FEEDING THE LARVAE OF THE DIFFERENT RACES ON THE  
DIFFERENT MULBERRY LEAF VARIETIES.

Source of variation	<u>A. Race Var (1959)</u>		Mean S. square	F.
	D.F.	Total S. square		
Varieties	5	0.04	0.008	8.9**
Error	54	0.05	0.009	
Total	59	0.09		
<hr/>				
	<u>B. Race Yinhan (1960)</u>			
Varieties	5	0.24	0.048	34.3***
Error	114	0.16	0.0014	
Total	119	0.40		
<hr/>				
	<u>C. Race 49 M. (1961)</u>			
Varieties	5	0.06	0.012	12.0***
Error	294	0.30	0.001	
Total	299	0.36		

\*\* Significant at the level 0.01

TABLE 13.

MULBERRY VARIETIES CLASSIFIED ACCORDING TO ORDER OF MERITS.

N°	Dry weight of cocoon		
	1959	1960	1961
1	Japanese L.	Japanese L.	Morettiana
2	Selvatica	Morettiana	Giazzola
3	Morettiana	Selvatica	Kokuso
4	Rosa di Lombardia	Rosa di Lombardia	Selvatica
5	Roumi	Roumi	Florio
6	Lhu	Lhu	Cattaneo
Weight of cocoon cortex			
1	Japanese L.	Japanese L.	Giazzola
2	Morettiana	Morettiana	Selvatica
3	Selvatica	Selvatica	Cattaneo
4	Roumi	Rosa di Lombardia	Florio
5	Rosa di Lombardia	Roumi	Florio
6	Lhu	Lhu	Morettiana

RESUME

ETUDE DE L'EFFET DE L'ALIMENTATION DE DIFFERENTES RACES DE VERS  
A SOIE AVEC CERTAINES VARIETES DE MURIER SUR LES GLAN-  
DES SERICIGENES ET LES CARACTERES BIOMETRIQUES DU COCOON .

1°) EFFET SUR LES GLANDES SERICIGENES : Les larves mûres des races Var et Yinhan nourries de feuilles de mûrier Morettiana furent observées; le réservoir de leurs glandes séricigènes fut trouvé le plus lourd. Pour la race 49 M ce furent les larves nourries de feuilles de Giazzola qui eurent les réservoirs les plus pesants.

2°) EFFET SUR LES COCONS : Les variations de dimensions des cocons des différentes races étudiées furent très faibles suivant les variétés de mûriers utilisés.

Poids des cocons : Les cocons secs les plus lourds des races Var x Yinhan, furent trouvés parmi ceux dont les larves avaient été nourries de Japanese L. Pour les 49 M les cocons secs les plus lourds furent ceux dont les larves avaient été nourries de Morettiana.

Poids des coques : Pour les races Var x Yinhan les coques les plus lourdes étaient celles des vers nourris de Japanese L. Pour les 49 M celles dont les vers avaient été nourris de Giazzola.

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