37. Investigation on Protection of Silkworms from the Diseases to Stabilize the Cocoon Yield, with Special Regard to the Sericultural Practices in Cooperative Rearing House of Young Silkworms and Farmhouses (2)

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This investigation was carried out to follow the previous paper (1), especially to get the information on actual occurrence of silkworm diseases in farmhouses in wet season.

MATERIALS AND METHODS

1. Locality surveyed : Self-help land settlement, Pimai, Korat.

2. Rearing seasons and farmhouses surveyed : Four and five farmhouses were mainly surveyed in July rearing season (HAKITATE, July 7), and in August – September rearing season (HAKITATE, August 31), respectively.
General situation of rearing houses and silkworm rearing in farmhouses surveyed are shown in Table 1.
Main items of survey and their methods were the same as in the previous paper (1). Other necessary description on the survey will be shown in each of items related to.

RESULTS

1. Amount of cocoons harvested.

Cocoon yield per box in May rearing season before this survey was generally high and exceeded 20 kg in most of farmhouses.

In July rearing season,however, the yield became highly low in every of farms, and the mount of cocoons harvested were less than 9 kg per box on the average in whole farmhouses of the settlement, though young silkworms were reared in the cooperative rearing house and delivered unexpectedly to individual farmhouses at the 2nd sleep due to shortage of mulberry leaves in the joint field. Farm F got the lowest amount of 7.6 kg per box in the season.

Subsequently, in August – September rearing season, the yield of cocoon per box was as high as 24.4, 26.8, 29.0, 15.3, 29.0, and 23.0 in A, B, C, F, G farmhouses and the average of whole farmhouses in the settlement, respectively.

2. Inspection of the diseases in grown silkworms.

The results are shown in Tables 2 – 4.

In the survey on July 25, 3 – 5th day of the 5th instar, most grown silkworms were externally healthy except a small number of those affected with flacherie and *Aspergillus* diseases, though there had appeared some undergrown worms from their earlier stages in these farmhouses.

Some of undergrown worms were collected and reared in the Centre. Most of them presented later the symptoms of either flacherie, cytoplasmic polyhedrosis or *Aspergillus* disease. The flacherie disease was most dorminant.

The survey on August 3, after cocooning, revealed that there were a lot of dead or still living, but uncocooning, worms, fallen down from cocooning frames to the floor, in every farmhouse. Some of them showed the bodies getting flaccid and flackish in color, some had small flecks on their skin or legs, and others did not spin without apparent signs of diseases. There were scattered white mucous feces in some places under cocooning frames, and a few of uncocooning worms developed later mycelial cluster of *Aspergillus* on their skin.

Microscopical observations on these diseased worms revealed that a small number of worms had polyhedra in midgut, diagnosed as cytoplasmic polyhedrosis-infected ones. No nuclear polyhedrosis diseased worms were observed.

Most of uncocooning silkworms having no polyhedra in both of midgut and body fluid were referred to as flacherie for a time. The whole bodies of several worms infected with flacherie were homogenized and centrifuged differentially at low or high speed. Subsequently, the supernatant parts after high speed centrifugation were smeared to mulberry leaves before feeding healthy young silkworms. Moreover, midguts from several diseased worms were similarly homogenized and centrifuged differentially. The fractions obtained, including percipitation resolved, were differentially used for feeding tests. However, transmisibility of each of fractions was extremely low.

From these results, it was demonstrated that uncocooning worms did not have strong infectivity, so they might not be infectious flacherie at least.

Survey on the cocoons shipped from some farmhouses showed that high mortality of silkworms was recognized, attaining about 80% in the highest case as seen in farm I. The causes of death were most dorminant in *Aspergillus*, followed by grassery-flacherie and Tachinid fly in order.

In August – September rearing season, the survey on September 17, at the 2nd to 5th day of the 5th instar, revealed that there happened a small number of *Aspergillus* and flacherie worms, but most of them attained their full growth. However, on September 21, lots of uncocooning worms appeared in common with all farmhouses. And some of them were affected with *Aspergillus*. But, on the whole, the cocoon crops were better than in July rearing season. Farm F did not make body surface disinfection to silkworm larvae, harvesting the cocoons of only about 15 kg per box.

3. Feeding tests of dust-smeared mulberry leaves and inspection on *Aspergillus* spores in dust samples, feces, and litters on rearing beds.

The results are shown in Tables 5 – 10.

Seeing comprehensively the results, the kinds of pathogens detected in dust samples were highly limited in number, in order of *Aspergillus* and flacherie. No cytoplasmic and nuclear polyhedrosis diseases were detected except in case of farm E. *Aspergillus* had a tendency showing higher population before disinfection in most of farmhouses on July 19. Farm E was rather specific; many of worms fed on mulberry leaves smeared with dust samples from mulberry room were earlier dead in one or two days after feeding, waving sometimes their heads just as they got poisonous chemicals. And some of them developed mycelia of *Fusarium*, but it was not clear that the fungus was fatal to the 1st instar larvae. This fact was repeatedly made sure in the 1st instar, but less effective on the 2nd instar larvae. In addition, in farm E,

nuclear and cytoplamic polyhedrosis pathogens were detected at a considerably high rate in rearing room on June 19 and July 13.

On the other hand, media tests revealed that dust samples collected from some sites of rearing houses had contained frequently a fairly number of *Aspergillus* spores before and after formalin disinfections. Generally, the population was higher before disinfection, and decreased after disinfection, though it increased again with starting of silkworm rearing.

The results of survey on *Aspergillus* fungi showed that they have been inhabitting constantly and abundantly feces and litters on rearing beds.

DISCUSSION AND CONCLUSION

Generally, in Thailand, bad crop of cocoons occurs frequently in wet season. From the results obtained in this paper, in May rearing season the harvest of cocoons was considerably rich and seriously poor in July rearing season. This bad crop in the latter seemed to be in the high incidence of the uncocooning worms after mounting.

The bad crop seemed to be the worst for the farmers, as the silkworms become dead or diseased just before making cocoons after having fed a plenty of mulberry and having used much labor for taking care of them. In August – September rearing season a fair lot of cocoons was harvested, nevertheless many uncocooning worms appeared after mounting.

Japan have had long years of suffering from uncocooning worms and accordingly a history of research on them. In the process of this research, the cytoplasmic polyhedrosis disease have been rediscovered and confirmed its important role in the occurrence of uncocooning worms. On the other side, infection with a small amount of nuclear polyhedrosis virus and bacterial flacherie have been pointed out as other causes of uncocooning worms. In addition, attack with *Aspergillus* on orifice of spinneret of silkworm is also said to be one cause of uncocooning. Thus, the causes of uncocooning are complicated, and it takes usually a long period for the clarification.

Un cocooning worms seen in this paper were tentatively referred as flacherie, but future research might request its modification, as *Aspergillus* might sometimes take more important role, based on the fact that *Aspergillus* infected worms were much prevalent and its spores distributed widely and densely in the rearing sites of silkworms. So, the attack on orifice of spinneret with *Aspergillus* might be probable as the cause of uncocooning worm.

In Addition, usual grown silkworm rearing in the country under higher temperature and humidity might cause some disorders in physiology of the worm, the so-called flacherie, and accordingly uncocooning worms.

Nuclear and cytoplasmic polyhedrosis diseases, which occurred less in grown silkworms as well as in dust samples, might be less possibility in relation to uncocooning worms. The details remain to be unsolved.

Actual disinfections performed by farmhouses would be required further improvement in such points as amount of disinfectant, its dilution ratio, times and intervals of application, and others; unsufficient disinfection becomes one of big causes of bad crops. The feeding tests or media tests proved that *Aspergillus* distributed most widely among pathogens. Consequently, it is evident that controlling *Aspergillus* disease is the most essential question for stable harvest of cocoons.

LITERATURE

(1) ISHIJIMA, T. *et al.*: Investigation of silworms from the diseases to stabilize the cocoon yield, with special regard to the sericultural practices in cooperative rearing house of young silkworms and farmhouses. Bul. Thai. Seri. Res. and Train. Centre, No. 9, 1979.

Table 1. General situation of rearing house and silkworm rearing (1979)

Farm-house	Building used for rearing	Items[1] of survey	Silkworm rearing		
			May (HAKITATE, May 18)	July (HAKITATE, July 7)	August-September (HAKITATE, Aug. 31)
A	Structure; a house of concrete block.	(1)	2	2	2
	Floor space; 9 x 6 m	(2)	47.2 (23.6)	23.7 (11.9)	48.8 (24.4)
	Floor; concrete made	(3)	–	3ℓ	3ℓ
	Mounting room; different from rearing room, lower floor of dweling (no didinfection)	(4)	No. did	(6-7% Ceresan)	Ceresan
		(5)	3rd sleep	2nd sleep	3rd sleep
B	Structure; same as A	(1)	3	2	2
	Floor space; 11 x 5 m	(2)	63.2 (21.1)	17.5 (8.8)	53.5 (26.9)
	Floor; concrete made	(3)	–	5ℓ	5ℓ and chlorine cleaning
	Mounting room; same as rearing room	(4)	–	every days, low concentration about 1.5% ceresan)	
	Entrance; two sides	(5)	3rd sleep	2nd sleep	No used
C	Structure; same as A	(1)	4	No rearing	3
	Floor space; 14 x 6 m	(2)	117.3 (29.3)		87.0 (29.0)
	Floor; concrete made	(3)	–		5ℓ
	Mulberry room; separated two	(4)	–		for young; two times for each instar for 4th, every two day. 5th, one time
	Mounting room; same as A Entrance; two sides	(5)	No used	–	No used

Table 1. (Continued)

Farm-house	Building used for rearing	Items[1] of survey	Silkworm rearing		
			May (HAKITATE, May 18)	July (HAKITATE, July 7)	August-September (HAKITATE, Aug 31)
D	Structure; a house of slate wall	(1)	2	1	No rearing
	Floor space; 10 x 4 m	(2)	35.8 (17.9)	9.7 (9.7)	
	Floor; concrete made	(3)	3ℓ	2ℓ	
	Entrance; two sides	(4)	–	10% ceresan	
	Mounting room; same as B	(5)	3rd sleep	2nd sleep	
E	Structure; same as A	(1)	1.5	1	No rearing
	Floor space; 8 x 4 m	(2)	30.0 (20.0)	8.9 (8.9)	
	Floor; concrete made	(3)	–	2ℓ	
	Mounting room; same as B	(4)	–	for 4th, 2 times 5th, 3 times	
	Entrance; one side				
	No shadow trees; mulberry store room impossible to use due to heat; leaves stored in rearing room	(5)	3rd sleep	2nd sleep	
F	Structure; same as D	(1)	3	2	3
	Floor space; 12 x 4 m	(2)	64.0 (21.3)	15.5 (7.6)	45.9 (15.3)
	Floor; concrete made	(3)	–	3ℓ	3ℓ
	Mounting room; same as B	(4)	lime only	lime only	No used
	Entrance; one side	(5)	3rd sleep	2nd sleep	3rd sleep (not clean in rearing room)
	There were mounting tools in mulberry room.				
G	Structure; same as D	(1)	1	No rearing	1
	Floor space; 7 x 4 m	(2)	26.5 (26.5)		29.0 (29.0)
	Floor; concrete made	(3)	–		3ℓ
	Mounting room; same as B	(4)	–		for 4th 1 time; 5th, no use
	Entrance; one side	(5)	3rd sleep		3rd sleep

Remarks: 1) Number in parenthesis is shown as follows, (1) no of box reared, (2) amount of cocoonsis (kg) harvested (average per box), including good and bad cocoons, (3) Amounts of formalin used, (4) Body surface disinfection (Ceresan lime was used usually), (5) Stage of delivery from the cooperative rearing house.

Table 2. Disease occurrence in individual farmhouse
(July rearing season, 1979)

Date of collection	Farmhouse	No. of examined	No. of silkworm by causes death[1]							Remarks
			A	M	N	C	F[3]	T	H	
July 25, A	A	23	2	0	0	2	7	5	–	
(3–5th day of	B	25	5	0	0	1	4	15	–	
5th instar)	D	1	0	0	0	0	1	0	–	
	E	12	6	0	0	1	1	4	–	
July 25 B[2]	A	28	1	0	0	2	25	0	0	
(3–5th day of	B	13	5	0	0	2	5	0	1	
5th instar)	D	4	0	0	0	1	3	0	0	
	E	17	0	0	0	3	12	0	0	
Aug. 3[2]	A	251	17	0	0	2	232	0	–	Many uncocooning worms
(after cocooning)	B	120	4	0	0	4	112	1	–	Many uncocooning worms
	D	27	21	0	0	1	3	1	–	Collected after discarded, uncocooned
	E	91	4	0	0	4	83	0	–	

Remarks: 1) Abbreviations are shown as follows, A; *Aspergillurs*, M, Muscardines, N; Nuclear polyhedrosis, C; Cytoplasmic polyhedrosis, F; Flacherie, T; Tachinidi fly, H; Healthy.
2) Undergrown silkworms were collected and reared at the Centre, and diagnosed after their death.
3) Most of worms were uncocooning ones after mounting.

Table 3. Disease occurrence in cocoons after shipment
(July rearing season, 1979)

Farmhouse	No. of examined	No. of diseased silkworms (%)	No. of sikworms by cause of disease				Amount of cocoons harvested per box (kg)
			Grassery-flacherie	*Aspergillus*	Tachinid fly	*Aspergillus* + fly	
A	150	24 (16.0)	0	10	2	12	11.9
B	150	8 (5.3)	2	4	0	2	8.8
(H)	150	89 (59.3)	0	58	27	4	7.1
(I)	152	121 (79.6)	26	55	21	19	10.3
(J)	150	65 (43.3)	11	42	12	0	7.9

Table 4. Disease occurrence in individual farmhouse
(August-September rearing season, 1979)

Date of collection	Farmhouse	No. of examined	No. of silkworms by causes of disease[1]							Remarks
			A	M	N	C	F[2]	T	Other	
Sept. 17	A	39	22	0	0	0	10	7	0	Undergrowth
(2–5th day of	B	5	0	0	0	0	4	0	1	Good growth
5th instar)	C	0	0	0	0	0	0	0	0	Good growth
	F	33	8	0	0	0	3	22	0	
	G	3	1	0	0	0	1	1	0	Good growth
Sept. 21	A	62	15	2	0	0	34	11	0	Uncocooning
(after mounting)	B	76	13	1	0	0	62	0	0	Uncocooning
	C	107	12	1	0	0	94	0	0	Good cocoons, but many uncocooning worms
	F	81	28	2	0	0	46	0	5	Many dead worms, no body surface disinfection
	G	36	9	0	0	0	25	0	2	

Remarks: 1) Abbreviations are shown in Table 2.
2) Most of worms were uncocooning ones after mounting.

Table 5. Disease occurrence of the silkworm fed on mulberry leaves smeared with dust samples collected from rearing sites at farmhouse, (1) Farmer A

Place	Date of collection	Working state		The rate of disease (%)						No. of colony of *Asp.* in dust samples
		Rearing	Disinfection	A	Fu	N	C	F	Total	
Mulberry Room	June 19	Before	Before	2	0	0	0	2	4	>100
	July 13	Before	After	0	0	0	0	0	0	0
	July 17	2-3rd day of 5th instar	–	0	0	0	0	2	2	80.5
	July 25	After cocooning	–	0	0	0	0	0	0	10
	Aug. 3	Before	Before	0	0	0	0	1	1	–
	Sept. 7	Before	After	0	0	0	0	0	0	3
	Sept. 17	2-3rd day of 5th instar	–	0	1	0	0	0	1	>100
	Sept. 21	Cocooning	–	0	0	0	0	0	0	>100
Rearing Room	June 19	Same as stated above		31	0	0	0	3	34	>100
	July 13			0	0	0	0	0	0	0.5
	July 17			0	0	0	0	0	0	56.5
	July 25			0	0	0	0	0	0	5
	Aug. 3			4	0	0	0	0	4	–
	Sept 7			0	0	0	0	0	0	0
	Sept. 17			0	0	0	0	0	0	>100
	Sept. 21			2	0	0	0	1	3	>100
Mounting Room	June 19	Same as stated above		4	0	0	0	3	7	>100
	July 13			1	0	0	0	0	1	>100
	July 17			–	–	–	–	–	–	–
	July 25			0	0	0	0	0	0	>100
	Aug 3			1	0	0	0	0	1	–
	Sept. 7			–	–	–	–	–	–	–
	Sept 17			0	0	0	0	0	0	59
	Sept. 21			4	0	0	0	1	5	>100

Table 6. (2) Farmer B

Place	Date of collection	Working state		The rate of Disease (%)						No. of colony of *Asp.* in dust samples
		Rearing	Disinfection	A	Fu	N	C	F	Total	
Mulberry Room	June 19	Before	Before	–	–	–	–	–	–	64
	July 13	Before	After	0	0	1	0	1	2	1
	July 17	2-3rd day of 5th instar	–	–	–	–	–	–	–	*20.5*
	July 25	After cocooning	–	0	0	0	0	1	1	58.5
	Aug. 3	Before	Before	0	0	0	0	0	0	–
	Sept. 7	Beofre	After	–	–	–	–	–	–	–
	Sept. 17	2-3rd day of 5th instar	–	1	0	0	0	1	2	59
	Sept. 21	Cocooning	–	–	–	–	–	–	–	>100
Rearing Room	June 19	Same as stated above		0	0	0	0	1	1	–
	July 13			0	0	0	0	1	1	–
	July 17			0	0	0	0	0	0	–
	July 25			0	0	0	0	0	0	–
	Aug. 3			3	0	0	0	0	3	–
	Sept. 7			9	0	0	0	4	13	–
	Sept. 17			0	0	0	0	0	0	–
	Sept. 21			0	0	0	0	0	0	–

Table 7. (3) Farmer C and D

Farm	Place	Date of collection	Working state		The rate of disease (%)						No. of colony of *Asp.* in dust samples
			Rearing	Disinfection	A	Fu	N	C	F	Total	
C	Mulberry Room	Sept. 17	2-3rd day of 5th instar	–	0	0	0	0	5	5	>100
	Rearing room	Sept. 17	After cocooning	–	7	0	0	0	2	9	>100
D	Mulberry Room	June 19	Before	Before	8	0	0	0	1	9	>100
		July 13	Before	After	0	0	0	0	1	1	–
		July 17	2-3rd day of 5th instar	–	1	0	0	0	0	1	>100
		July 25	After cocooning	–	2	0	0	0	0	2	*184*
		Aug. 3	Before	Before	4	0	0	0	1	5	338.5
	Rearing Room	June 19	Same as stated above		31	0	0	0	3	34	>100
		July 13			1	0	0	0	0	1	58
		July 17			9	0	0	0	3	12	88.5
		July 25			8	0	0	0	4	12	119
		Aug 3			2	0	0	0	0	2	>100

Table 8. (4) Farm E, F and G

Farm-house	Place	Date of collection	Working state		The rate of disease (%)							No. of colony of *Asp.* in dust sample
			Rearing	Disinfection	A	Fu	N	C	F	Others[1)]	Total	
E	Mulberry Room	June 19	Before	Before	0	0	0	0	0	93	93	45.5
		July 13	Before	After	2	0	0	0	0	95	97	21.5
		July 17	2-3rd day of 5th instar	–	3	0	2	0	0	24	29	6.0
		July 25	After cocooning	–	0	0	0	0	0	57	57	100.5
		Aug. 3	Before	Before	2	0	0	0	0	1	3	–
	Rearing Room	June 19	Sames as stated above		18	0	20	0	0	0	38	100
		July 13			0	1	10	3	0	0	14	93.5
		July 17			3	0	1	0	0	0	4	211.5
		July 25			4	0	1	0	0	0	5	>100
		Aug. 3			1	0	2	0	7	0	10	–
F	Mulberry Room	Sept. 17	Same as stated above		5	0	0	0	0	0	5	>100
	Rearing Room	Sept. 17			10	0	0	0	0	0	10	>100
G	Mulberry Room	Sept. 17	Same as stated above		6	0	0	0	0	0	6	>100
	Rearing Room	Sept. 17			9	0	0	0	0	0	9	>100
	Control (No feeding of mulberry without smearing)				0	0.5	0	0	0	0	0.5	–

Remarks: 1) The worms in Farm E were dead in two days after feeding due to unknown cause, waving their heads just as they got poisonous chemicals.

38. Effectiveness of Some Fungicides in Controlling Aspergillus Disease of Silkworm (3)

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"Ceresan lime" has been used widely and effectively in controlling *Aspergillus* and Muscardine diseases of silkworms in Thailand. "Ceresan lime", however, showed to be replaced by other safer and effective disinfectants as soon as possible, based on possible harmful effects to human beings due to its active ingredient "organic mercury".

This study was repeatedly undertaken to find out some applicable disinfectants for the control of *Aspergillus* disease of the silkworm, following the previous reports (2), (3), (4). In this paper, several disinfectants which have been used practically and effectively in controlling the diseases as the substitute of "Ceresan lime" in Japan, as well as "Chlorinated lime" and "Pafsol" produced in Thailand, were tested for practical use in the country.

MATERIALS AND METHODS

The silkworm race used:, K14 x K1

The disinfectants tested and their main ingredients;

(1) "Kaiyo Pafsol" ("New Pafsol" in the previous paper)(4) – Paraformaldehyde 3.0% (Riken Adsol Industry Co.)

(2) "Thai Pafsol" – Paraformaldehyde 5%, Bonzoic acid 10% (The Government Pharmaceutical Organization)

(3) "Kabinoran" – Tetrachloroisophthalonitrile 2.0%, Manganese ethylenebis (dithiocarbamate) 2.0% (TAKEDA Chemical Industry Co.)

(4) "Kinubon" – Strontium quinolinolate 5.0% (HOKKO Chemical Industry Co., Ltd.)

(5) "Sosan S" – H Benzoic acid 5.0% (SAITAMA Prefectural Society for Research of Sericultural Science)

(6) "Shin sosan dust 2" – Paraformaldehyde 2.5%, Benzoic acid 2.0% (SAITAMA Prefectural Society for Research of Sericultural Science)

(7) "Shin shin dust 2" – Salicylic acid 4.0%, Paraoxybutyl benzoate 3.0%, (SAITAMA Prefectural Society for Research of Sericultural Science)

(8) "Chlorinated lime" – Chlorine 2%, (VIDHYASOM Co., Ltd.)

(9) "Ceresan lime" – Phenyl mercuric acetate 5%.

The time of test; 3 rearing seasons, June to October in 1979.

The strain of *Aspergillus*: the isolate of *A. Flavus*, Pi_2.

The 1st–, 2nd–, and 4th instar larvae just after ecdycis were employed for inoculation with the fungus. The concentration of *Aspergillus* spore suspension was adjusted to 4×10^3 spores per mm^3. Fifty larvae were used in each of treatments with three replications. The larvae were inoculated by a dipping method; the 1st, 2nd and 4th instar larvae were dipped in 2, 3

and 4 ml, respectively, of the spore suspension under the same concentration, and then every larva was stirred with a brush for three minutes in order to smear well the body with spores. Inoculated worms were moved onto a filter paper, and were dusted with disinfectants after having dried their body surface approximately one hour later.

Applications of the chemicals were made one time in most cases, but one and two times in some cases for each instar of the worms. Although the dosage of chemicals applied to the 1st, 2nd, and 4th instar was 10, 20, and 40 g per 1 m^2, respectively, in the test of June rearing season. As a few chemicals such as "Sosan S" seemed to have a harmful effect on the 1st instar larvae, in August and October rearing seasons, the dosages of these chemicals were decreased to 8 g for the 1st instar larvae, as shown in Tables 2 – 3.

The worms were reared by being wrapped in a sheet of paraffin paper. The mortality of the larvae was daily recorded. The tests were terminated when the 1st, 2nd, and 4th instar larvae reached the 3rd, 4th instar, and matured stage, respectively.

RESULTS

1. In June rearing season, "Ceresan lime" was most effective among seven disinfectants tested for the 1st instar larvae, followed by "Shin-shin dust". However, the other five disinfectants showed the mortality rising to 90 percent (Table 1).

In the respective silkworms dusted with "Sosan S", "Shin sosan dust", and "Shin shin dust", the high percentages of dead larvae were observed shortly after dusting on the "Hakitate" day. These seemed to be caused by the harmful effects of the disinfectants on young silkworms under the given conditions.

In the test of each of the 2nd and 4th instars, the mortality lowered generally, showing almost the same effectiveness as "Ceresan lime" in most of disinfectants except "Kabinoran".

2. In the tests of August rearing season, each dosage of "Sosan S", "Shin shin dust", and "Shin sosan dust 2" was decreased to 8 g per m^2 to avoid the direct damage from chemicals. Consequently, newly hatched larvae were slightly damaged by these chemicals.

In the test for the 1st instar larvae, the effectiveness of "Kairyo Pafsol" or "Shin shin dust" was on the same level as that of "Ceresan lime". For the 2nd instar larvae, "Ceresan lime" and "Kairyo Pafsol" were most effective, followed by "Shin sosan dust", "Kinubon", "Kabinoran, and "Shin shin dust". For the 4th instar larvae, "Kairyo Pafsol" was most effective, followed by the other chemicals "Chlorinated lime" showed somewhat inferior effectiveness to the other disinfectants for every instar larva tested. In this rearing season, a few of the 4th instar larvae were attacked with other disease than *Aspergillus* inoculated.

3. In October rearing season, no harmful effect on the 1st instar larva was observed. For the 1st instar larvae, "Shin shin dust" almost showed the same effectiveness as "Ceresan lime". For the 2nd instar larvae, most of disinfectants were effective. For the 4th instar larvae, all disinfectants were effective, but "Chlorinated lime" was somewhat inferior to the others.

Though the effectiveness of "Kairyo Pafsol" seemed generally to be superior to that of "Thai Pafsol", further investigation on the comparison of effectiveness between both chemicals will be required.

On the other hand, throughout all the season's tests, an increase in dusting time (two times for each instar) did not clearly produce the effectiveness in controllying *Aspergillus* disease.

DISCUSSION

From the results above mentioned, "Ceresan lime", among the chemicals tested, though it has some possible harmful effects to human beings or animals, was most effective in controlling *Aspergillus* disease. This may be caused by the fact that the *Aspergillus* isolate used in the experiments was not yet tolerant to mercury (1). However, "Kairyo Pafsol", "Kinubon", "Sosan S", "Shin sosan dust", and "Shin shin dust" were designated as the disinfectants next to "Ceresan lime" in effectiveness of controlling *Aspergillus* disease. So, it may be concluded that these disinfectants are valuable for the practical use in controlling the disease in sericultural farmhouses, though they might require more careful administration to the silkworm than "Ceresan lime". "Chlorinated lime" was slightly less effective than the others, and also "Thai Pafsol" seemed to be less useful than "Kairyo Pafsol". So, these chemicals would have a little room for further improvement. "Sosan S", "Shin sosan dust" and Shin shin dust" caused occasionally harmful effects on the newly hatched larvae, showing that the greatest care must be taken in the dosage of chemicals or in dusting uniformly when they will be applied to the young silkworms. Among the 1st, 2nd and 4th instar larvae used in the experiment, the mortality of the 1st instar larvae inoculated was remarkably high even after administration of chemicals. This might be caused by the inoculation with too much high spore concentration of 4×10^3, improbable in nature, to young silkworms, because even the 4th instar larvae were killed at a high rate at the same concentration. Consequently, we may say that those disinfectants mentioned above have sufficient effectiveness to protect the susceptible 1st instar larvae from natural spread of *Aspergillus* disease. However, in the future investigation, this point should be demonstrated clearly to get any difference in effectiveness for newly hatched silkworms by using different spore concentrations.

On the other hand, an increase in dusting time (twice for each instar) did not produce remarkable improvement in effectiveness. This seemed to be caused by less efficacious results in the second dusting, because the first dusting might killed almost all of spores inoculated, and the spores, completely invaded into the skin, were not affected by the second dusting Under the natural rearing conditions which silkworms are exposed to be invaded by the spores, continuously provided in the sericultural conditions, an increase in dusting time may surely work for controlling the disease.

SUMMARY

The repeated attempts to find out new disinfectants as substitute of "Ceresan lime" showed that they were originally effective in controlling *Aspergillus* disease.

However, "Kairyo Pafsol", "Kinubon", "Sosan S", "Shin sosan dust" and "Shin shin dust" were designated as the disinfectants next to "Ceresan lime" in effectiveness of controlling *Aspergillus* disease. These disinfectants might be valuable for the practical use in controlling the disease in sericultural farmhouses, though they might demand more careful administration under the directions of the chemicals". "Sosan S", "Shin sosan S", and "Shin shin dust" caused occasionally harmful effects on the newly hatched larvae, therefore the greatest care should be taken in dusting uniformly a correct dosage of chemicals when they will be applied to the young silkworms.

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Table 1. Mortality (%) of the 1st, 2nd, and 4th-instar larvae in June rearing season, 1979

Disinfectants	Times of dusting in each instar	Instar inoculated		
		1st	2nd	4th
Kairyo Pafson	1	96.0	21.3	25.3
Kabinoran	1	98.7	76.7	67.3
Kinubon	1	99.3	23.3	16.7
Sosan – S	1	93.3*	38.0	39.3
Shin sosan dust	1	90.0*	44.0	18.0
Shin shin-dust 2	1	76.7*	39.3	25.3
Ceresan lime	1	44.0	24.0	18.0
Kairyo Pafsol	2	98.7	16.7	12.7
Kabinoran	2	99.3	64.7	70.7
Ceresan lime	2	29.3	7.3	20.0
Control 1 (Inoculated)	0	100.0	100.0	96.0
" 2 (Not inoculated)	0	ND	2.0	14.7

Remarks:

(1) The mortality (%) was shown in the average of 3 replications consisting of 50 worms each.
(2) HAKITATE: June 11, 1979.
(3) Dosage of each of disinfectants applied to the 1st, 2nd, and 4th instar was 10, 30, and 50g per 1 m^2, respectively.
(4) * High percentage of dead larvae was observed shortly after dusting on the "HAKITATE" day. This seemed to be caused by any harmful effects of the disinfectant.
(5) ND means "not done".

Table 2. Mortality (%) of the 1st, 2nd, and 4th instar larvae in August rearing season, 1979

Disinfectants	Times of dusting in each instar	Instar inoculated		
		1st	2nd	4th
Kaiyo Pafsol	1	79.3	18.0	24.7 (5.3)
Kabinoran	1	99.3	52.7	45.3 (7.3)
Chlorinated lime	1	100.0	97.3	73.3 (6.7)
Kinubon	1	96.0	52.7	46.7 (4.0)
Sosan – S	1	89.3*	75.3	45.3 (4.7)
Shin sosan dust	1	87.3*	46.0	47.3 (4.7)
Shin shin-dust 2	1	80.0*	55.3	42.0 (0.7)
Ceresan lime	1	80.7	27.3	20.0 (4.0)
Kairyo Pafsol	2	78.7	30.7	29.3 (0)
Kabinoran	2	99.3	62.0	67.3 (8.0)
Ceresan Llime	2	74.0	32.7	23.3 (7.3)
Control 1 (Inoculated)	0	100.0	100.0	96.7 (3.3)
Control 2 (No inoculated)	0	0	0	6.0 (2.7)

Remarks:

(1) HAKITATE: August 15.

(2) Dosage of disinfectant with * mark was decreased 8g per $1m^2$ to 1st instar.

(3) The number in parentheses shows worms died of different diseases from Aspergillus.

(4) Other remarks are the same as (1) and (3) in Table 1.

Table 3. Mortality (%) of the 1st, 2nd, and 4th-instar larvae in October rearing season, 1979

Disinfectants	Times of dusting in each instar	Instar inoculated		
		1st-	2nd-	4th-
Kairyo Pafsol	1	88.0	18.7	19.3 (0.7)
Thai Pafsol	1	88.7	48.7	34.0 (0.7)
Kabinoran	1	100.0	42.7	25.3
Chlorinated lime	1	75.3	42.0	42.7 (0.7)
Kinubon	1	89.3	25.3	13.3
Sosan – S	1	92.7	30.7	11.3
Shin sosan dust	1	87.3	32.0	22.0
Shin shin-dust 2	1	44.7	17.3	24.0
Ceresan lime	1	42.0	36.0	10.7
Kairyo Pafsol	2	88.7	25.3	5.3
Kabinoran	2	96.7	27.3	26.0 (0.7)
Ceresan lime	2	48.0	25.3	9.3
Control 1 (Inoculated)	0	100.0	99.3	67.3 (4.7)
" 2 (No inoculated)	0	0.7(4.0)	0.1	0 (0.7)

Remarks:

(1) HAKITATE: October 10, 1979

(2) Other remarks are the same as (1), (3) in Table 1 and (2), (3) in Table 2.

39. Some Observations on the Symptoms in the Grown Silkworms Inoculated with Aspergillus

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Aspergillus disease, which is one of the most widespread and destructive diseases in Thailand, cases various kinds of symptoms to the silkworm. Infected in the young stages of silkworms, their corpses are immediately covered with a characteristic cluster of mycelia without decomposing, though they do not show the noticeable disease specks. So the diseased silkworm may be made a diagnosis as *Aspergillus*-infected one with comparative ease. However, when infected growm larva was dead, hardening of the corpse is limited to the area of penetration of the fungi, and the other area, where mycelia are not fully grown, is decomposed by the bacteria in the digestive organ. This causes sometimes to be mistakenly diagnosed as a flacherie diseased worm to an *Aspergillus*-diseased one.

In tropical Thailand, as reported in muscardine diseases of the silkworm (1), a diagnosis of the disease is forced to be generally accompanied by much difficulty, as many of the corpses are decomposed without developing mycelial cluster on the surface of the body, due to speedy growth of bacteria existing always in the digestive organ of the silkworm under higher atmospheric temperature.

Therefore, some observations have been made on the expression of disease symptoms of *Aspergillus* and the development of its mycelial cluster on dead body in order to get useful information for diagnosis of the disease.

MATERIALS AND METHODS

(1) The silkworm race used: K14 x K1

(2) Inoculum: the isolate of *Aspergillus flavus* P_{12}.
Spore concentration inoculated: 4×10^3 spores per mm^3.

(3) Stages inoculated: the 4th and 5th instar larvae.

(4) Duration of experiments: on the 4th instar, Nov. 24 to Dec. 10, 1979, and on the 5th instar, Oct. 25 to Nov. 15, 1979.

(5) Temperature and humidity during rearing: 4th instar; 25 – 32°C, average 28.9°C and 60 – 90%, average 78.8%. 5th instar; 26 – 33°C, average 28.9°C, and 56 – 95%, average 68.8%.

Inoculated by dipping in spore suspension of *Aspergillus* when the worms newly exuviated to each of 4th and 5th instars, the silkworms tested were reared by being wrapped with paraffin paper.

The worms treated with body surface disinfection were dusted with Ceresan lime everyday from the 3rd day after inoculation until making cocoons to eliminate natural and secondary infection of the fungus. Inspections on the silkworms tested were made twice a day and recorded.

The test conditions for developing mycelial cluster were made in a 9 cm petri dish each, as follows:

(1) Natural; on a sheet of dry filter paper.
(2) Wet; on a sheet of wet filter paper.
(3) Medium; on Rose Bengal Agar.

The petri dishes were kept at room temperature during observations.

The tests were terminated when the larva pupated.

RESULTS

1. The incubation and fatal periods in the larvae inoculated at the 4th instar.

The results are shown in Table 1. The inoculated worms showed various kinds of symptoms, and the type produced fleck of light brown in color on skin appeared most frequently, attaining its rate of 28%, followed by such types as change in color of skin to brown after ecdysis, unecdysis, constipation, prolapse and so on. Flaccid worms appeared at a low rate in both of inoculated and uninoculated groups, so they seemed to be induced by other causes.

Among larvae inoculated, some without any symtoms made cocoons later. The incubation period of the silkworm infected ranged generally 3.5 to 10 days except worms being flaccid and dead in cocoon. The worms producing fleck showed somewhat a shorter incubation period of 5.0 days on the average than that of 6.5 days in the worms suffering from constipation.

The fatal period of the diseased larvae ranged 4.0 to 14.0 days. The period in the worms with fleck on skin was somewhat shorter than that in the others. The only three worms with fleck on skin made cocoons later, but all of them were dead before pupation in cocoons. The fatal periods of the worms affected with unecdysis, uncomplete ecdysis, and prolapse of anus were 6.9, 7.6, and 6.5 days, respectively, but none of them made cocoons. A very few number of worms which suffered from change in color of skin and constipation made cocoons or pupated later.

2. The positions of body expressed the perceptible symptoms, and the formation of mycelial cluster after death in the larvae inoculated at the 4th-instar.

The results are shown in Table 2.

In the type expressing fleck, the symptoms appeared mostly at the positions as head, caudal, abdomen and lateral. About 93% of these worms developed mycerial cluster after death at each of the positions which had expressed the fleck at the initial stage of the disease.

The worms suffering from unecdysis and uncomplete ecdysis developed differentially the mycerial clusters after death at the various positions of head, lateral and caudal. These parts developing the clusters might be referred to as the actual parts of invasion which caused abnormality in ecdysis with pathogen.

Almost half of the worms suffered from the change in color of skin, developed later the mycelial clusters at only the caudal part, but the others did not develop them at any place.

The worms suffering from constipation and prolapse of anus developed the cluster at only the caudal part as a matter of course.

None of flaccid worms developed the mycelial cluster in the same way as the control (no-inoculated), so it may be confirmed that they were caused by different pathogen from

Aspergillus inoculated. In case of silkworms inoculated at the 4th instar, the rate of developing the cluster was about 57%, even if the flaccid worms were excluded from the calculation. The fact might provide some difficulty in a diagnosis of *Aspergillus* after death.

3. The rate of developed mycelial cluster and its perceptible period on the body after death under the different conditions in the larvae inoculated at the 4th stage.

The results are shown in Table 3.

The rate of developed mycelial cluster and its perceptible period did not show generally possible difference depending on conditions between natural and wet in almost all symptom types. However, so far as the constipated worms are concerned, 40% of them developed the cluster under wet condition, but not under natural condition. The period until developing the cluster ranged generally 0.5 to 3 days after death.

4. The incubation and fatal periods in the larvae inoculated at the 5th instar.

The results obtained are shown in Table 4.

In case of larvae inoculated at the 5th instar, the symptom types were extremely simple, limited to the only fleck on skin, as the 5th instar larvae did not exuviate during incubation period of the disease.

In a treatment with everyday body-disinfection from the 3rd day after inoculation, average incubation and fatal periods were 4.4 and 5.6 days, respectively, and they were not greatly different from those in the worms inoculated at the 4th instar. Six worms which had expressed fleck on skin made cocoons later, but all of them were dead in cocoons without pupation. In a treatment without the disinfection, the fatal period was the similar days as in the disinfection, though the worms which had died in cocoons due to *Aspergillus* disease increased somewhat in number.

Flaccid worms were slightly recognized in every treatment including the control, so they seemed to be caused by different pathogen from *Aspergillus*. In the control, there appeared a few worms expressing the symptoms of *Aspergillus* with somewhat longer incubation period, so they seemed to be naturally infected during the experiment.

5. The positions of body expressed symptoms in the larvae inoculated at the 5th instar.

The results are shown in Table 5.

The disease fleck appeared at various parts of the body such as head, abdomen, lateral, and caudal with the same tendency in both of the body surface disinfected and no-body surface disinfected groups.

6. The rate of developed mycelial cluster and its perceptible period on the body after death under different conditions in the larvae inoculated at the 5th stage.

The results are shown in Table 6.

The observations on the development of mycelial cluster were made under each of natural, wet, and medium conditions.

Most of worms which had expressed the disease speck on skin developed later mycelial cluster at a high rate regardless of the conditions. The period until developing the cluster

was mostly one day, ranged 0.5 to 3 days. None of the clusters developed in the flaccid worms, probably caused by other pathogen.

DISCUSSION

The results obtained in this paper would provide highly useful information on the practical diagnosis of the grown larvae attacked with *Aspergillus* disease.

The worms inoculated with the pathogen at the 4th instar have expressed the various types of symptoms, and some of them did not develope the mycelial cluster after death even under a wet condition. Therefore, these facts might give more difficulty for an exact diagnosis as *Aspergillus* diseased worm. On the other hand, the worms infected at the 5th instar showed rather simple symptom type, and most of them developed mycelial cluster after death, so they might be diagnosed with comparable ease, if they are kept under wet condition even in the case of black-colored and partially decomposed body.

Generally, disease factors in the practical rearing conditions of silkworms in farmhouses would be interacted with many complicated environments such as infection time, population of pathogen, susceptibility of silkworms and others, and the rearing beds on which leaves and shoots of mulberry piled up over and over will provide the most favorable conditions for bacterial growth. Consequently, the worms, attacked with the disease, would be very easily taken with the change in color and decomposition of the body, and loosing of the characteristic fleck immediately after death, yielding even inhibition of developing mycelial cluster under the hottest weather. These facts would make the diagnosis of diseased silkworm still more difficult under the practical rearing conditions than under these experimental ones

Therefore, the research work should be further requested in connection with these factors in order to establish more efficient method for diagnosis under practical rearing conditions of farmhouses.

SUMMARY

The silkworms inoculated with *Aspergillus* spores at the 4th instar expressed various types of symptoms such as "flecks on skin", "unecdysis", "incomplete ecdysis", "change in color of skin after ecdysis", "constipation" and "prolapse of anus", with the incubation period ranging 3.5 to 12.5 days. In addition, some of them did not develop the mycelial cluster after death even under wet condition. On the other hand, the worms infected at the 5th instar showed rather simple symptom type to be limited to "flecks on skin" and most of them developed mycelial cluster after death.

From the results, it may be concluded that the worms infected at 4th instar give more difficulty than ones infected at the 5th instar for an exact diagnosis of the disease.

LITERATURE

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Table 1. Incubation and fatal periods in the silkworm inoculated with *Aspergillus* at the 4th instar

Treatments	Types of symptoms	No. of expressed (%)	Incubation[1] period Range (average) (days)	Fatal period[1] Range (average) (days)	No of cocoon made	
					dead	pupated
Inoculated	No. of worm examined	167				
	Fleck on skin	48 (28.7)	3.5-10.5 (5.0)	4 0-14.0 (5.5)	3	
	Uneedysis	16 (9.5)	5.5 (5.5)	6 5- 7 0 (6.9)		
	Incomplete ecdysis	7 (4.2)	5 5 (5.5)	6 5- 8 5 (7.6)		
	Change in color of skin to brown after ecdysis	21 (12.6)	5.5- 6.0 (5.7)	7.5-11 5 (8.5)		3
	Constipation	13 (7.8)	6.5 (6.5)	9 5-14 0 (11.3)	3	1
	Prolapse of anus	5 (3 0)	5 5- 6.0 (5.8)	6 5 (6.5)		
	Flaccidness	8 (4 8)	11.5-12 5 (12 1)	11.5-12 5 (12 1)		
	Without symptoms	49 (29 3)				49
Control (no inoculated)	Flaccidness	2 (1 8)	14.0 (14 0)			
	Without Symptoms	107 (98 2)				107

Remarks 1) The dead worms after making cocoon were excluded from the calculation.

Table 2. Position of body expressed the symptoms and their formation of mycelial cluster after death in the silkworm inoculated with *Aspergillus* at the 4th instar

Types of symptoms	No. of expressed	No. of developed mycelia (%)	Positions of body expressed symptoms (development of mycelial cluster after death)						No. of cocoon made	
			head	abdo-men	lateral	dorsal	caudal	double position	dead	pupated
No. of worm examined	167	91 (57.2)[1]								
Fleck on skin	48	45 (93.7)	15(14)	10(9)	7(7)	1(1)	11(10)	4(4)	3[2]	
Unecdysis	16	15 (93.8)	(3)	(0)	(5)	(0)	(7)			
Incomplete ecdysis	7	4 (57.1)	(1)	(0)	(3)	(0)	(0)			
Change in color of skin to brown after ecdysis	21	13 (61.9)	(0)	(0)	(0)	(0)	(13)			3
Constipation	13	9[3](69.2)	(0)	(0)	(0)	(0)	13(9)		3	1
Prolapse of anus	5	5[3](100)	(0)	(0)	(0)	(0)	5(5)			
Flaccidness	8	0								
Without symptoms	49									49

Remarks: 1) The flaccid worms were excluded from the calculation.
2) These worms had the fleck, but made cocoons later.
3) These do not include the worms which made cocoons later.

Table 3. The rate of developed mycelial cluster and its perceptible period on the body after death under different conditions in the silkworm inoculated with *Aspergillus* at the 4th instar.

Types of symptoms	Conditions tested	No. of[1] tested	No. of developed mycelia (%)	Period until developing mycelia. Range (average), (day)
Fleck on skin	natural	20	19 (82.6)	0.5–3.0 (1.3)
	wet	25	23 (92.0)	0.5–1.5 (1.1)
Unecdysis	natural	8	7 (87.5)	0.5–1.5 (0.9)
	wet	8	7 (87.5)	0.5–1.5 (0.9)
Incomplete ecdysis	natural	1	0	
	wet	6	4 (66.7)	0.5–1.0 (0.9)
Change in color of skin after ecdysis	natural	9	7 (77.7)	0.5–3.0 (1.0)
	wet	9	6 (66.7)	1.0–3.0 (1.3)
Constipation	natural	4	0 (0)	
	wet	5	2 (40.0)	2.0 (2.0)
Prolapse of anus	natural	3	3 (100.0)	1.0–2.0 (1.3)
	wet	2	2 (100.0)	2.0 (2.0)
Flaccidness	wet	8	0 (0)	

Remarks: 1) A total of ten worms which had made cocoons later was excluded.

Table 4. Incubation and fatal periods in the silkworm inoculated with *Aspergillus* at the 5th instar

Treatments	Types of symptoms	No. of[1] expressed	incubation[2] period Range (average) (day)	Fatal period[2] Range (average) (day)	No. of cocoon made	
					dead	pupated
Inoculated, body surface disinfected	Flecks on skin	164	3.5-9.0 (4.4)	3.5-9.0 (5.6)	6	0
	Flaccidness	1	8.5 (8.5)	8.5 (8.5)		
	Without symptoms until making cocoon	35				
	developed mycelia	4			4	
	flacherie-like	1			1	
	pupated	30				30
Inoculated, no body surface disinfected	Fleck on skin	143	3.5-8.5 (4.7)	3.5-9.0 (5.8)	2	0
	Flaccidness	2	5.5-8.5 (7.1)	5.5-8.5 (7.1)		
	Without symptoms until making cocoon	55				
	developed mycelia	13			13	
	flacherie-like	2			2	
	pupated	40				40
Not inoculated, body surface disinfected	Flecks on skin	2	6.5-7.0 (6.8)	6.5-7.0 (6.8)		
	Fleaccidness	18	4.5-8.0 (5.7)	4.5-8.0 (5.7)		
	Without symptoms	180			0	180

Remarks: 1) The number of worm tested was 200 per treatment.
2) The worms died after making cocoon were excluded from the calculation.

Table 5. Position of body expressed the symptoms in the silkworm inoculated with *Aspergillus* at the 5th instar

Treatments	No. of expressed	Positions of body expressed symptoms					
		Head	abdomen	lateral	dorsal	caudal	double positions
Inoculated, body surface disinfected	164	39	30(1)[1]	43 (1)	7	26	11
Inoculated, no body surface disinfected	143	24	29	28 (3)	18	29	12

Remarks: 1) The number in parenthesis shows the number of worm with two flecks.

Table 6. The rate of developed mycelial cluster and its perceptible period on the body after death under different conditions in the silkworm inoculated with *Aspergillus* at the 5th instar.

Treatment	Type of symptoms	Conditions tested	No. of[1] tested	No. of developed mycelia (%)	Period until developing mycelia Range (average), (day)
Inoculated, body surface disinfected	fleck on skin	natural	89	88 (98.9)	0.5 - 3.0 (0.8)
		wet	55	55 (100.0)	0.5 - 2.0 (0.9)
		media	20	20 (100.0)	0.5 - 2.0 (0.9)
	flaccidness	natural	–	–	
		wet	–	–	
		media	1	0	
Inoculated, no body body surface disinfected	fleck on skin	natural	68	68 (100.0)	0.5 - 3.5 (0.8)
		wet	46	46 (100.0)	0.5 - 1.5 (0.8)
		media	29	29 (100.0)	0.5 - 2.0 (1.0)
	flaccidness	natural	–	–	
		wet	–	–	
		media	2	0	

Remarks. 1) The worms made cocoon were excluded.

40. Survey on the Silkworm Disease in Cocoons Brought in the Centre from Self-help Land Settlements and Others

Thongchai SITTISONGKRAM, Sumanee KWANMING, Chirasak PENTMESRI, Sukit THAMPRANEE, and Takashi ISHIJIMA

In recent years the production of cocoon from self-help land settlements by the use of bivoltine silkworm race is gradually increasing. However, there is reportedly a serious problem of occasional bad crops due to silkworm diseases, threatening the stable production of cocoon (3). Moreover, the percentage of eliminated cocoons was frequently high, though it varied with their locality and even in the same locality with the season of shipment (1) (2). Nevertheless, their actual conditions on the kind of disease, the degree of damage, the cause of outbreaking and so on have not been grasped exactly so far. Therefore, as means of clarifing the conditions of disease occurrence, a series of survey was made on the silkworms in the cocoons brought in the Centre for their classification and drying or reeling from some of self-help land settlements and others. As a result of it, among these cocoons high percentages of diseased silkworms were unfortunately and frequently recognized.

MATERIALS AND METHODS

About 100 to 150 cocoon specimens were taken out from cocoon bag lots brought in the Centre from every settlement surveyed. After cutting open the cocoons, the worms were classified in healthy or dead and sick ones. The dead or sick worms, except ones with disease of known etiology, were kept under a wet condition in pertri-dishes in a 25°C incubator. After incubation for 3 to 7 days, the mycelia growing on their body surface were classified into each of *Aspergillus*, Muscardines, *Fusarium* as causes of death, depending on the kinds of them. The worms which did not grow mycelia were referred to as a grassery-flacherie group, accompanied by the careful microscopical observation on the existence of polyhedra in the bodies. Furthermore, the diseased worms having polyhedra might be concerned in either nuclear polyhedrosis or cytoplasmic-polyhedrosis, and others having no polyhedra might be flacherie.

RESULTS

The results of survey on the cocoons brought in over fourty times from fourteen different rearing places from June, 1979 to February, 1980 are shown in Table 1.

The predominating disease was *Aspergillus* throughout almost whole period of the survey, followed by grassery-flacherie. Tachnid fly, though the rate was considerably low, had also given continuous damages throughout the period of the survey.

The occurrance of muscardine disease was generally low with a few exceptional cases.

According to the microscopical observations, among a few number of silkworms showing grassery-flacherie symptoms, only a few worms had polyhedra in the bodies. Therefore, most of them might be referred to as flacherie-diseased ones, but not nuclear polyhedrosis – or cytoplasmic polyhedrosis – deseased ones

Generally, the high mortality of the silkworm in cocoons did not answer our expectation in most of the settlements. It was over 40% in eleven specimen lots. The highest mortality was 70% in the cocoons brought in on July 24 from Ubolrat settlement, followed by 65.6% on February 12 from Lam Dom Noi settlement. The predominating disease was grassery-flacherie in both settlements.

In case of Kamsoi settlement, the mortality exceeded 40% in five out of six times of the survey, and its predominating disease was caused by *Aspergillus*. However, the mortality was highly decreased in October rearing season, reflecting the decreasing *Aspergillus* disease with the incoming of dry season. Similar tendency could be seen in other settlements, as far as *Asporgillus* disease was concerned, showing extremely high disease rate in wet season, but considerably low rate in dry season.

An outbreak of grassery-flacherie in January-February rearing season at Lam Dom Noi settlement was an exceptional case in dry season, though its closer investigation was left.

DISCUSSION

The results obtained in this survey showed that the mortality of the silkworm in cocoons was unexpectedly high. Dead worms in cocoons cause generally decreasing amount of good cocoons harvested, as well as lowering their quality and even machine trouble in reeling process when selection of cocoon was unproperly made.

Though this survey on the diseases in cocoons was extremely restricted, this may offer a good means for estimating some actual conditions of bad crops due to silkworm disease in each settlement surveyed. From this point of view, these would rather offer the fact that farmers at settlements had been extensively undergone serious damages from the silkworm diseases, adding the fact that they had made unsufficiently selection of cocoon for shipment.

In this survey, *Aspergillus* and grassery-flacherie diseases were most prodominant in many rearing places. This proved that these pathogens abundantly have existed in rearing environment. If so, silkworms might be exposed to serious danger of bad crops. Consequantly, these pathogens might victimize young silkworm larvae more easily than grown ones, if tey were prevalent in rearing sites. Therefore, we get easily to the idea that a number of silkworm larvae would die at a high rate during younger stage in most of the settlements which showed high mortality of silkworm in cocoon. In fact, depending on our inquiries to the settlement offices, for instance, average amount of cocoon harvested per a sheet of silkworm egg was no more than 10.6 kg in July rearing season at Chiengpin settlement, and average price of cocoon was only 40 baht per kg in July rearing season at Karbcherng silk project.

Needless to say, in these settlements it is an urgent problem to succeed in controlling silkworm diseases in order to get more stable and profitable harvest of cocoon.

The main factors causing bad crops are supposingly imperfect disinfection and careless handling of the silkworm larvae at grown stage. After all, more thorough formalin disinfections before rearing and body surface disinfections should be requested to farmers in these settlements. During wet season, *Aspergillus* fungi are especially prevalent, so the greatest care should be taken to body surface disinfection. On the other hand, it is of importance to disinfect larva on 2 to 3 days before mounting as well as to disinfect mounting tools for the purpose of decreasing the mortality of the silkworm in cocoon, as matured silkworms become more susceptible to *Aspergillus* disease than grown ones. In addition, it is highly recommended in tropical Thailand to make a good care to rearing environments by avoiding the high temperature and humidity in the rearing and mounting rooms, and keeping them well-ventilated during grown and mounting stages of the silkworm.

SUMMARY

The mortality of worms in cocoons, brought in the Centre over fourty times from different fourteen rearing places from June 1979 to February 1980, was unexpectedly and frequently high, attaining 70% in the highest case. The predominating cause was *Aspergillus* throughout almost whole period of survey, followed by grassery-flacherie and Tachinid fly. *Aspergillus* had a extremely high disease rate in wet season, but considerably low rate in dry season. Among grassery-flacherie diseases, only a few worms had polyhedra. There happened exceptionally an outbreak of grassery-flacherie disease even in dry season at a settlement.

These facts suggest that thorough performance of formalin and body-surface disinfections and improvement of rearing environments, in particular for grown worms, are indispensable to get more stable harvest of cocoons in farmhouses.

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Table 1. Result of survey on the silkworm diseases in cocoons brought in the Centre from self-help land settlements and others

Place of rearing	Date of bringing in	No. of cocoon examined	No. of dead silkworm (mortality %)	Grassary-flacherie	No. of silkworm by causes of death					Variety	Amount of cocoon brought in (kg)
					Asper-gillus	Muscar-dine	*Fusa-rium*	Tachinid fly	Others[1]		
1 Kamsoi	June 12, '79	113	66 (58.4)	20.5 (20 5-1)[2]	44	0	0	1.5	0	K1xK8	753.5
2	July 26	120	49 (40.8)	23	33	8	0	8	0	Unknown	291.3
3	Aug. 3	116	58 (50.0)	10 (8-0)	44	0	0	4	0	K1xK8, K1xK18	510.4
4	Aug 21	150	64 (42.7)	28 (15-0)	28	0	4	4	0	K1xK8	322.4
5	Sept. 12	140	57 (40.7)	16 (2-0)	39	0	0	2	0	NxC	748.5
6	Oct. 19	115	3 (2.6)	0	1	2	0	0	0	Unknown	1,631 1
7 Pongpisai	June 12	112	30 (26.8)	8	8	14	0	0	0	K1xK8	400.9
8	Aug. 2	165	53 (32.1)	18 (8-0)	40	2	0	3	0	K1xK8	526.0
9	Nov. 5	145	37 (25.5)	31	2	0	0	3	1	K1xK8	586.9
10 Lampao	June 29	135	20 (14.8)	13	4	0	2	1	0	K1xK8	462.3
11	July 28	139	33 (23.7)	16	11.5	0	0	6.5	0	K1xK8	254.5
12	Nov. 1	135	4 (3 1)	4	0	0	0	0	0	K18xK1	552.7
13 Karbcherng	July 16	120	50 (41.7)	26	24	0	0	0	0	Imported	313.5
14	Aug 28	124	33 (26.7)	3	30	0	0	0	0	C x N	322.4
15	Nov. 8	120	10 (8.3)	5	0	0	0	5	0	K1xK8	855.7
16	Jan. 14 '80	108	4 (3.7)	4	0	0	0	0	0	K13 x K8	296.8
17	Feb 13	135	9 (6.7)	8	1	0	0	0	0	K1xK8	342.5
18 Ubolrat	July 24, '79	80	56 (70.0)	30 (5-0)	14	0	0	12	0	Unknown	379.7
19	Aug. 21	116	49 (42.2)	0	47	0	0	2	0	K1xK8	858.2
20	Sept. 11	131	57 (43.5)	18	26	0	0	13	0	N x C	731.9
21	Dec. 28	115	30 (26 1)	11	3	0	0	0	0	Unknown	994.2
22	Oct. 16	129	30 (23 3)	2	14	2	0	12	0	Unknown	1,110 4

(Continued)

Place of rearing	Date of bringing in	No. of cocoon examined	No. of dead silkworm (mortality %)	No. of silkworm by causes of death						Variety	Amount of cocoon brought in (kg)
				Grassary-flacherie	*Asper-gillus*	Muscar-dine	*Fusa-rium*	Tachinid fly	Others[1)]		
23 Prasart	July 27, '79	210	36 (17.1)	19	10	2	0	5	0	K1xK8	617.9
24	Sept. 10	120	19 (15.8)	10 (7-0)	4	0	0	5	0	N x C	570.9
25	Nov. 29	120	10 (8.3)	5	0	0	0	5	0	K18xK1	277.2
26 Chieng pin	July 28	112	53 (37.3)	14	34	2	0	3	0		
27 Bangruad	July 29	120	40 (33.3)	7 (2-1)	29.5	0	0	3.5	0	K1xK8	740.2
28	Sept. 10	117	24 (20 5)	11	6	0	0	7	0	N x C	396.1
29	Oct. 27	109	7 (6.4)	7	0	0	0	0	0	K1xK8	140.8
30 Lamdomyai	July 31	134	15 (11.2)	10	4	1	0	0	0	K1xK8	525 1
31	Sept. 11	119	14 (11.8)	6 (1-0)	7	0	0	1	0	N x C	270.7
32	Oct 29	153	14 (9 1)	12	0	0	0	2	0	K1xK8	492.0
33 Lamdomnoi	Sept. 9	121	46 (38 0)	15 (2-0)	28	0	0	3	0	N x C	203.6
34	Feb. 12, '80	154	101 (65 6)	86	13	0	0	0	1	K1xK8	92 0
35 Kuchinarai	Aug 6, '79	111	48 (43 2)	3	33.5	3	0	8.5	0	K1xK8	1,122.5
36 Kabinburi	Aug 21	115	17 (14.8)	9	8	0	0	0	0	Unknown	192 3
37	Oct. 2	200	41 (20 5)	36	5	0	0	0	0		
38 Prachinburi	Sept. 11	150	4 (3.1)	4	0	0	0	0	0	N x C	50.8
39 Pimai	Sept 27	660	77 (11.7)	37	24	0	3	13	0	Unknown	192 3
40	Nov. 22	113	7 (6.2)	5	2	0	0	16	0	Unknown	420 1

Remarks: 1) Dead worms due to ants or unknown cause.

2) The numbers in parentheses in the column of causes of death show the number of silkworms having polyhedra in the body under microscope. Some silkworms were dead of double causes with each mark of 0.5.

41. Trials to Isolate the Causal Agent of Root Rot Disease of Mulberry, with Special Regard to the Pathogenicity of a Bacterial Isolate B-1 to the Leaf Shoot, and Root of Mulberry.

Luan BOONNAB and Takashi ISHIJIMA

The root rot disease of mulberry is seriously prevailing in many districts in the country at present. The disease can devastate mulberry plantations in a few years, if it would once occur. However, neither positive demonstration of the cause of the disease nor its effective countermeasures have been worked out, though some fungus isolates were obtained from the rotted plant (1), (2), (3).

Among a few of isolates with possible pathogenicity to mulberry, a bacterial isolate B-1 was the most pathogenic to leaves, stems and root of mulberry.

MATERIALS AND METHODS

As inoculum sources, the root, cortical parts of root, and stem of mulberry infected naturally, with fresh symptoms, were gotten in the plantations of the Center, Phuttaisong Sericultural Experiment Station, and Pimai mulberry field for the cooprative rearing of young silkworms.

The media used for isolation and culturing of microbes were Potato dextrose agar (PDA, adjusted PH to 5.0 for isolation), Corn meal agar (CMA), and Czapek dox agar (CDA). King's media A, modified King's media and Nutrient broth (NB) were occasionally used for culture or enrichment of bacteria isolated. The growth of microbes was observed on the 3rd day after transplanting. All isolates were subcultured from a single hyphae or colony and maintained mainly on PDA media in test tubes.

The methods for isolation and inoculation were reported in the previous paper (2). The pathogenecity tests were made on detached leaves, shoots, and roots cutted about 6 – 10 cm in length. These materials for inoculation were usually wounded with a knife or a bundle of needles prior to inoculation. After inoculation the materials were kept in 15 cm petri-dishes containing a sheet of wet filter paper and incubated at 30 ℃.

As a control, the materials wounded and put on no-culturing medium were used.

As inoculum of *Melanconium spp*, the stockculture obtained in the previous paper (2) was used.

RESULTS

Isolation tests were repeatedly made throughout a year except a few months in dry season. Many kinds of fungi and bacteria were isolated. Consequently, they were roughly classified without detailed identification. Some of results from tests repeatedly carried out on the frequency of isolation in each of microbes are shown in Table 1. The colonies of *Fusarium*, Bacteria, *Diplodia* and *Pythium* appeared most frequently in each of media. *Macrophomina phaseolina*, which causes seedling blight, charcoal rot and root rot of at least 400 plant species, was rarely isolated. The only isolate having shown pathogenicity so far to mulberry leaves and stems in the previous paper (2) was identified as *Melanconium spp*, but none of them were isolated this year.

Thus, about 19 isolates were repeatedly subcultured on PDA medium and used for inoculation tests. The tests were made individually or conprehensively for each isolate. In the test on October 2, one isolate of *Fusarium* (P-6) from materials taken at Pimai, developed lesions on 8 leaves out of 12 inoculated. In addition, in the test on October 28, 19 isolates were conprehensively inoculated to detached leaves. One out of 19 isolates of bacteria developed lesions on the leaves inoculated. This bacterial isolate B-1 was frequently isolated on PDA from materials at Pimai and Phuttaisong. The lesion due to B-1 isolate spread to a whole leaf and finally rotted it. Another bacterial isolate B-2 did not develop any lesion. Any other fungi, including *M. Phaseolina*, developed no lesion on the leaves inoculated. The results of the pathogenicity with main four isolates are shown in Table 2. *Melanconium spp.* were pathogenic to leaves and frequently stems. The inoculation with these organisms had been repeatedly made to potted plants, but no diseased plants have appeared so far. *Fusarium* isolate P-6 was pathogenic to leaves, but not to stems and roots.

B-1 isolate was pathogenic to leaves, shoots and even roots inoculated. The lesion development on the leaves, shoots, and roots inoculated with the isolate are shown in Tables 3-5. In case of leaf, the blackish lesion appeared on the 2nd day after inoculation and enlarged rapidly, and then rotted almost whole leaf on the 7th day after inoculation. In case of roots, the rotting started at the place wounded and inoculated, and enlarged to its adjacent areas.

The pathogenicity with B-1 isolate to leaves, shoots and roots has been repeatedly confirmed in other experiments.

No rotting occurred in each of parts wounded simply in all control plants.

Preliminary inoculation tests with B-1 isolate were made to potted young plants by pouring a certain amount of liquid culture (NB) of 5 days after transplanting into the soil of the pots. In most cases, the bacterial cultures were pathogenic, inducing stop of the growth, yellowing and dropping of leaves to the inoculated plants, and finally killed the plants at a high rate. Whereas they were less effective on the comparatively bigger plants, growing for 3 months or over, after transplanting to the pots. The various inoculation tests to the whole plants are under way at present.

B-1 isolate was negative in Gram staining, and produced green pigment in colonies on King A media. Moreover, the isolate was no pathogenic to potato tuber and carrot root.

DISCUSSION AND CONCLUSION

Among 19 different isolates in total cultured from the rotted parts of mulberry, only three isolates had the respective pathogenic effects on the detached leaves.

The first fungus, *Melanconium spp*, was pathogenic to both leaf and shoot of mulberry, but its isolation rate from diseased parts was extremely low.

The second one, an isolate of *Fusarium sp.* was pathogenic to the leaf alone, though it was always isolated in high frequency.

The third one, a bacterial isolate B-1, was highly pathogenic to not only leaf, but also shoot and root of mulberry, and occasionally even to the plants of younger age. Consequently, at the present status, the B-1 isolate seemed to be the most probable microorganism as the causal agent of root rot disease of mulberry. Moreover, judging from the highly restricted experimental results, the B-1 isolate seemed to be *Pseudomonas sp.* or its affinity.

In general, there are very few bacteria which have been designated as the etiological agent of root rot disease of plants. On the other hand there was a report on the root rot disease of mulberry, caused by *Pseudomonas* in Japan *(4).* This information might give a strong support to our results on B-1 isolate. Therefore, a comparable study on the similarity between the *Pseudomonus sp* and B-1 isolate will be urgently required.

For the confirmation of B-1 isolate as the causal agent, further study will be requested on its frequency of isolation, distribution in soil, seasonal prevalence, conditions for disease occurrence, in addition to its identification, bacteriological properties and synergism with other microbes for disease occurrence.

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Table 1. Frequency of fungi and bacteria isolated from root rot-diseased mulberry tree (1979)

Date of isola-tion	Places collected diseased tree	Media[1] used	Kinds of isolates obtained [2] [3]						
			Diplo-dia	*Melanco-nium*	*Macropho-mina*	*Fusarium* (more two species)	*Pythium*	Bacteria	Others
July 28	Phuttaisong	PDA	+++	–	–	++++	+++	+++	++
		CDA	++	–	±	++++	–	++++	+
		CMA	+++	–	+	++++	+	++++	+
Aug.14	Pimai	PDA	+++	–	–	++++	++	++++	++
		CDA	+++	–	+	++++	++	++++	++
		CMA	+++	–	–	++++	+++	++++	+++
Aug.20	Korat	PDA	++	–	–	++++	++	+++	++++
		CDA	++	–	–	++++	++	++++	++++
		CMA	+++	–	–	++++	+++	++++	+++
Aug.30	Phuttaisong	PDA	++	–	+	++++	++	++++	++
		CDA	+++	–	–	++++	–	++++	++
		CMA	++	–	–	++++	++	++++	+
Sept.18	Pimai	PDA	++	–	+	+++++	++	++	++
		CDA	++	–	–	++++	+++	++++	+
		CMA	+++	–	–	++++	+	++++	+
Oct 2	Phuttaisong	PDA	+	–	–	++++	–	++++	++
		CDA	+	–	–	++++	–	++++	–
		CMA	+	–	–	++++	–	++++	+
Oct 13	Phuttaisong	PDA	±	–	–	+±	+	±	±
		CDA	–	–	–	++++	–	++++	+
		CMA	±	–	–	+++±	–	±	±

Remakrs: 1) Media used: PDA; Potao dextrose agar (PH 5.0), CDA; Czapek dox agar, CMA, Corn meal agar (PH 6.0).

2) Temperature of incubation. 30°C.

3) ± shows less than 10 colonies and + shows 10 colonies on 10 petridishes in total, including medium for isolation

Table 2. Inoculation tests for main isolates from root rot diseased mulberry tree

Date of inoculation	Isolate	Leaf[1)]	Stem[1)]	Root[1)]
October 18, 1979	*Melanconium spp.*	10	8	0
	Macrophomina Sp.	0	0	0
	Fusarium sp. (P-2)	10	0	0
	Pythium sp	0	0	0
	Control	0	0	0
November 12, 1979	*Melanconium spp.*	10	7	0
	Macrophomina sp.	0	0	0
	Fusarium sp. (P-2)	10	0	0
	Pythium sp.	0	0	0
	Control	0	0	0

Remarks 1) 10 leaves, stems and roots of each of the samples were tested. In the table, the sample which developed the lesion after inoculation is shown in number.
2) Mulberry variety; Noi
3) Temperature of incubation; 30°C.

Table 3. The lesion development on the leaves inoculated with B-1 isolated (1979)

Days after inoculation[1)]	The leaf number inoculated and a long diameter of lesion (cm)[2)]									
	1	2	3	4	5	6	7	8	9	10
2	1.0	1.2	1.2	1.2	1.2	1.1	1.1	1.2	1.2	1.2
3	2.0	2.3	2.2	2.4	2.6	2.6	2.5	2.8	2.8	2.4
4	2.5	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
5	3.4	3.1	3.5	3.4	3.2	3.8	3.9	3.6	3.8	3.9
6	4.5	4.6	4.6	4.8	4.2	4.8	4.3	4.5	4.8	4.8
7	5.8	6.3	6.3	5.8	5.8	5.8	6.0	6.3	6.3	6.0

Remarks: 1) Date of inoculation; Dec. 6.
2) Mulberry variety used: Noi
3) Temperature for inoculation; 30°C.
4) No lesion appeared in wounded and uninoculated plants.

Table 4. The lesion development on the shoots inoculated with B-1 isolate (1979)

Days after inoculation	The shoot number inoculated and a long diameter of lesion (cm)							
	1	2	3	4	5	6	7	8
3	0.3	0.3	0.4	0.4	0.3	0.4	0.3	0.4
4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.4
5	0.7	0.8	0.8	0.7	0.8	0 8	0.8	0.8
6	0.9	0.9	0.9	0 9	0.9	1.0	1.0	1.0
7	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3

Remarks: 1) Date of inoculation; Dec. 12.
2) Other remarks are the same as Table 3.

Table 5. The development of rotting area in the roots inoculated with B-1 isolate (1979)

Test plant number	Date of observation				
	13	15	17	19	21
1	–	+	++	+++	++++
2	–	–	+	++	+++
3	–	–	–	+	++
4	+	++	+++	++++	D
5	+	++	+++	++++	D
6	+	++	+++	++++	D
7	+	++	+++	++++	D
8	–	–	+	++	+++
9	–	–	–	+	++
10	–	–	–	+	++
11	–	–	–	–	–
12	+	++	+++	++++	D
13	–	–	+	++	+++
14	+	++	+++	++++	D
15	+	++	+++	++++	D
16	–	–	–	+	++
17	–	+	++	+++	++++
18	–	–	+	++	+++
19	–	–	+	++	+++
20	+	+	+++	++++	D
21	–	+	++	+++	++++
22	–	–	+	++	+++
23	–	+	++	+++	++++
24	+	++	+++	++++	D
25	–	–	–	–	–
26	–	–	–	–	+
27	–	–	–	+	++
28	–	–	+	++	+++
29	–	–	–	–	–
30	–	–	–	–	–
31	–	–	–	–	–
Diseased rate (%)	29.0	41.9	64.5	80.6	83.9

Remarks: 1) –; No rotting, +; slightly rotting,
++; Rotting area, less than 0.5 cm
+++, Rotting area, 0.5 cm - 1.0 cm
++++; Rotting area, more than 1.0 cm
D; Dead, because of rotting of whole root

2) Roots of 6-8 cm in length were kept in 9 cm petridish containing a sheet of wet filter paper. Inoculation was made on December 11.

3) 10 control roots, only wounded and not inoculated, did not developed any lesions.

42. Comparison on Reeling Among Thai Native Cocoons, Bivoltine F_1 Hybrid x Thai Native Cocoons, and Bivoltine Hybrid Cocoons by Automatic Reeling Machine

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Chanya PANNENGPET

The native polyvoltine silkworms, which have resistivity against high temperatures in Thailand, produce usually small cocoons in size. The cocoons are not suitable for machine reeling for warp production. It seemed, however, to be promising that the cocoons of native strain mated by the bivoltine strain might be more useful to machine reeling than the cocoons of the former itself.

We tried to get the results to refer to machine relling by the use of these cocoons, comparing with cocoons of bivoltine silkworm race.

MATERIAL AND METHOD

1.	Form of experiment	:	Randomized Complete Blocks (R.C.B.) with 3 treatments (varieties) and 6 replications.
2.	Silkworm variety	:	(1) Thai native ploy voltine race: NongKai 4. (2) Bivoltine F_1 x Thai native race. (K_{18} x K_1) x NongKai 5 (3) Bivoltine F_1 Hybrid: K_1 x K_8
3.	Cocoons used	:	500 grams of cocoons (fresh weight) per reeling unit.
4.	Reeling condition	:	1). Cocoon cooking: by machine 2). Reeling machine: automatic reeling machine, KEINAN Type
5.	Size test	:	60 (10 skeins x 1 treatment x 6 replications) sample sizing skeins.

RESULT

Results are shown in Tables 1, 2, 3, 4, and 5.

From the statistically examined results, it was shown that there were highly significant differences among raw silk percentage, out-side waste silk percentage, and size of raw silk (Table 4).

From Table 5, the bivoltine hybrid race (K_1 x K_8) gave better results in tenacity, reelability percentage, cleanness and neatness percentage than the other races.

As a result, it may be said that both cocoons of NongKai 4 and (K_{18} x K_1) x NongKai 5 were unsuitable and inefficient for reeling by automatic reeling machine.

Table 1. Raw silk percentage (%)

Cocoons	Replication						Average
	1	2	3	4	5	6	
Nongkai 4	3.58	3.52	3.45	2.99	3.63	2.96	3.36
(K18xK1)xNongkai 5	12.36	11.94	11.46	11.17	11.72	11.42	11.68
K1xK8	15.37	16.39	15.33	15.36	16.37	16.09	15 82

Table 2. Out-side waste silk percentage (%)

Cocoons	Replication						Average
	1	2	3	4	5	6	
Nongkai 4	2.91	2.41	1.92	1.91	2.50	2.29	2.32
(K18xK1)xNongkai 5	1.69	1.87	2.05	2.05	1.80	1.95	1.90
K1xK8	1.47	0.74	1.00	1.10	0.64	0.75	0,95

Table 3. Size of raw silk (denier)

Cocoons	Replication						Average
	1	2	3	4	5	6	
Nongkai 4	15.34	16.68	16.75	16.40	18.35	17.17	16.78
(K18xK1)xNongkai 5	17.33	18.75	19.88	18.40	17.85	19.13	18.56
K1xK8	20.85	21.25	21.25	21.55	20 70	21.45	21.18

Table 4. Analysis of variance (ANOV)

SV.	df	Mean squares (F)		
		Raw silk (%)	Out-side waste silk (%)	Size of raw silk (d)
Replications	5	0.2836	0.0647	0.8374
Treatment	2	241.7522 (1865.37**)	2.9696 (30.55**)	29.3077 (54.64**)
Error	10	0.1296	0.0972	0.5364
CV %		3.5	18.1	3.9

Table of mean

Cocoons	Raw silk (%)	Out-side waste silk (%)	Size of raw silk (d)	Standard deviation of raw silk (d)
Nongkai 4	3.36	2.32	16.78	0.98
(K18xK1)xNongakai 5	11.68	1.90	18.56	0.91
K1xK8	15.82	0.95	21.18	0.33
Comparison between two treatment means				
LSD.05	0.46	0.40	0.94	
LSD.01	0.66	0.57	1.34	

Table 5. Tenacity, elongation, neatness and cleaness, and reelability.

Cocoons	Tenacity (g/d)	Elongation (%)	Cleanness and neatness (%)	Reelability (%)
Nongkai 4	3.0	20.60	13.42	20
(K18xK1)xNongkai 5	3.2	20.13	88.50	77
K1xK8	3.7	20.20	96.50	88

Remarks: Tenacity; 3.7 g/d or more represents the grades 5A-C
Tenacity; less 3.7 g/d represents the grade D.

43. Surveys on Raw Silk Quality of Bad Cocoons

Chanya PANNENGPET, Saengchan KUN-OWN, and
Weera NARKKUM

Though cocoon assorting before shipping should be done most carefully, we could see, as shown in the previous reports (1), that cocoons shipped from sericultural settlers contained quite a number of bad cocoons to be eliminated from reelable ones.

The surveys were performed to get some effects of various elminated cocoons on quality of warp to be used for Thai silk production.

MATERIAL AND METHOD

1. Eliminated cocoons : 9 kinds (see Table 1)

2. Reeling conditions :
   1) Cocoon cooking: by machine
   2) Number of cocoon used: 100 grams each of fresh cocoons to be eliminated
   3) Reeling machine: By multi-ends type

RESULT

Results are shown in Tables 1 and 2.

From Table 1, it proved that the quality of raw silk in the usage of bad cocoons was exactly inferior, showing the large number of defects in the cleanness test.

From Table 2, the tenacity of raw silk was low, but the degree of elongation stood in a ordinary situation.

As a result, it may be said that the eliminated cocoons are not suitable for warp production.

LITERATURE

(1) CHOMCHUEN, K. and C. PANNENGPET: Result of test reeling of cocoons produced by farmers. Bul. Thai Seri. Res. and Train. Centre, No. 6 – 8, 1976 – 1978.

Table 1. Cleanness defects

No.	Eliminated cocoon	Cleanness defects				Total
		Major defects	Minor defects			
		large slugs	small slugs	long loops	loose ends	
1.	Malformed cocoons	114	65	1	–	180
2.	Double cocoons	18	44	44	9	115
3.	Cocoons with prints of cocooning frame	–	21	47	21	89
4.	Inside soiled cocoons	–	13	80	26	119
5.	Thin-shelled cocoons	–	7	75	7	89
6.	Outside soiled cocoons	–	23	55	18	96
7.	Thin end cocoons	21	13	80	8	122
8.	Loose shell cocoons	8	12	96	5	121
9.	Pierced cocoons	19	19	75	10	123

Remarks: 100 panels each of lots were observed.

Table 2. Tenacity, elongation, and quantity of silk

No.	Eliminated cocoon	Tenacity (g/d)	Elongation (%)	Raw silk wt. (g)	Out-side waste silk (g)
1.	Malformed cocoons	3.14	20.56	7.81	2.60
2.	Double cocoons	2.52	17 64	1.97	1.32
3.	Cocoons with prints of cocooning frame	2.92	21.32	10.18	2.10
4.	In side soiled cocoons	3.38	21.52	5.57	1.34
5.	Thin-shelled cocoons	2.80	20.36	7.46	0.93
6.	Out-side soiled cocoons	2.88	20.68	7.29	1.71
7	Thin-end cocoons	3.23	22.20	10 48	2.53
8.	Loose-shell cocoons	3.21	21.50	13.11	2.02
9.	Pierced cocoons	–	–	6.00	3.00
	Average	3 01	20 72	7.76	1.95

Remark: A lot of eliminated cocoons for reeling. Fresh cocoons of 100 g.

44. Reeling Survey on the Cocoon of Different Varieties of Silkworm in 1979

Saengchan KUN-OWN and Chanya PANNENGPET

As in 1978 (1) reeling survey was done to judge the quality of cocoons produced by different strains of silkworms under breeding in the Centre, in order to obtain the data available to select better strains of silkworms.

MATERIALS

Cocoons tested were produced in January, June, August, and October 1979.

600 cocoons were tested on each strain, divided into 2 parts for test reeling.

METHOD OF REELING

1. Number of cocoons per sample: 600
2. Cocoon cooking: by basin
3. Reeling machine· multi-ends type
4. Number of cocoon for one thread: 10
5. Number of reeling ends: 5
6. Temperature of water in reeling basin: 40°C
7. Reeling velocity: 90m/min.

RESULT

Results are shown in Tables 1, 2, 3, and 4.

(1) According to the reeling test of cocoons produced in January as shown in Table 1, K_6 x K_{14} and K_6 x K_{16} varieties were better in raw silk percentage of cocoon shell and reelability.

(2) The results of reeling test of cocoons produced in June were summarized in Table 2. K_{13} x T and (K_1 x T). (K_6 x K_8) varieties were better in raw silk percentage of cocoon shell.

(3) Anong the cocoons produced in August (Table 3) K_1 x K_{18} and (K_1 x K_6).(K_8 x K_{18}) varieties showed better results in raw silk percentage of cocoon shell.

(4) In the reeling test of cocoons produced in October (Table 4), K_{13} x K_{18}, E_{25} x K_{18}, and E_{25} x E_{28} varieties were better in raw silk percentage of cocoon shell.

From the results, we can see that cocoon quality of silkworm variety is dependable on climate, for example, K_1 x K_{18} variety was tested 3 times in a year, resulting in the high reelability with 95% in August in the same manner as last August.

LITERATURE

(1) KUN-OWN, S and C. PANNENGPET, Reeling survey on the cocoon of different varieties of silkworm in 1978, Bul. Thai Seri. Res. and Train. Centre, No. 9, 1979.

Table 1. Results of reeling test of cocoons produced in January, 1979

No.	Race	Length of cocoon filament (m)	Weight of cocoon filament (cg)	Size of cocoon filament (d)	Reelability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)
1.	K1xK8	881	19.22	2.0	79	14.7	20.6	71
2.	K6xK8	1,056	23.53	2.0	84	17.2	21.8	79
3.	K1xK14	953	19.08	1.8	81	15.2	19.9	76
4.	K6xK14	1,220	26.91	2.0	85	19.2	22.4	81
5.	K1xK16	938	28.79	1.9	80	15.3	20.1	76
6.	K6xK16	1,003	24.88	2.2	93	17.9	21.9	82

Table 2. Results of reeling test of cocoons produced in June, 1979

No.	Race	Length of cocoon filament (m)	Weight of cocoon filament (cg)	Size of cocoon filament (d)	Reelability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)
1.	K1xK18	1,053	24.5	2.1	74	15.0	20.6	73
2	K13xT	1,131	27.0	2.2	55	15.7	20.1	78
3.	K13xK8	1,148	27.7	2.2	77	16.4	21.6	76
4.	K13xK16	1,169	27.5	2.2	79	15.9	21.0	76
5.	K13xK18	1,022	23.0	2.1	73	14.4	21.6	67
6.	E25xK18	862	22.4	2.4	74	14.4	20.7	70
7.	E25xE28	755	20.3	2.5	82	14.5	19.8	73
8.	(K1xT). (K6xK8)	963	24.8	2.3	68	15.3	19.9	77

Table 3. Results of reeling test of cocoons produced in August, 1979

No.	Race	Length of cocoon filament (m)	Weight of cocoon filament (cg)	Size of cocoon filament (d)	Realability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)
1	K1xK18	967	24.6	2.3	95	17.00	21.5	79
2	K13xT	851	21.9	2 3	61	14.58	20.1	72
3	K13xK16	1,076	23.3	1.9	84	14.31	21.2	68
4	K13xK18	1,007	24.7	2.2	95	16.40	22.5	73
5	E25xK18	925	23.3	2.3	86	16.20	20.7	78
6	E28xE25	811	21.1	2.4	86	14.96	20.3	74
7	(K1.T)x (K6xK18)	984	23.3	2.2	76	14.66	20.8	71
8	(K1xK6)x (K8. K18)	1,020	25.7	2.3	89	16.68	21.1	79
9	(K16. K18)x (K1. K6)	1,067	25.9	2.2	88	15.80	20.9	76
10	C x N	1,148	31.3	2.5	69	18.33	24.0	76
11	N112xC110	725	20.1	2.5	89	13.76	18.6	74
12	N115xC108	807	23.0	2.6	77	14.41	19.3	75
13	(K13 E25)x (K16. K18)	1,065	24.8	2.1	91	16.33	21.7	75
14	N112xC115	1,053	27.0	2.3	85	16.50	21.2	78
15	NxC	1,257	35.9	2.6	66	18 75	24.3	77

Table 4. Results of reeling test of cocoons produced in October, 1979

No.	Race	Length of cocoon filament (m)	Weight of cocoon filament (cg)	Size of cocoon filament (d)	Realability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)
1	K1xK18	957	20.4	1.9	92	15.4	20.8	74
2	K13xT	803	16.8	1.9	93	13.5	18.2	74
3	K13xK16	1,023	21.8	1.9	93	16.8	21.3	79
4	K13xK18	1,009	22.9	2.0	93	17.6	21.4	82
5	E25xK18	880	21.9	2.2	94	17 6	20.2	87
6	E25xE28	781	22.2	2.6	96	18.8	19.4	81
7	E28xE10	850	21.4	2.3	95	16.1	19 2	84
8	(K8. K18)x (K6 K1)	1,052	21.6	1.8	86	15.9	20.5	77
9	(K18. K16)x (K6. K1)	902	19 9	2.0	89	14.7	20.3	73
10	(K8. K18)x (K13. K1)	1,028	21.0	1.8	91	16.4	20.5	80
11	(K18. K16)x (K13. E25)	954	21.4	2.0	91	16.4	20.9	79

45. Result of Test Reeling of Cocoons Produced by Farmers in 1979

Konthawirat CHOMCHUEN and Chanya PANNENGPET

In the year, 1979, our Centre purchased the cocoons from many farmers in several districts of Thailand (Tables 1 and 2). All these cocoons were produced from eggs supplied to them by the Centre and Stations. They were estimated on the quality by test reeling in our laboratory, taken at random 600 cocoons per lot as a sample, divided into two equal numbers in order to repeat the test reeling as the same way as in last year (1).

METHOD

1. Number of cocoons per sample : 600
2. Cocoon cooking: by basin
3. Reeling machine: multi-ends type
4. Number of cocoons for one thread. 10
5. Number of reeling ends: 5
6. Temperature of water in reeling basin. 40°C
7. Reeling velocity: 90 m/min.

RESULTS

The results are shown in Tables 1 and 2.

The Tables 1 and 2 showed the respective results of cocoons, purchased by our Centre and each private silk company.

From the data, we can see that the amount of cocoons produced by farmer had an increase of 16,856.50 Kgs. or 81.76% over last year. And in the test reeling results, it was recognized that the reelability (76.84%) and raw silk percentage of cocoon shell (76.70%) were elevated, compared with last year, though average of cocoon shell percentage, raw silk percentage, and length of cocoon filament were slightly lowered, and also, eliminated cocoon percentage rose, probably owing to careless assorting of cocoons. Careful assorting to have a direct effect on the price of cocoons should be carried out strictly.

LITERATURE

(1) CHOMCHUEN, K. and C. PANNENGPET: Result of test reeling of cocoons produced by farmer in 1978. Bul. Thai Seri. Res. and Train. Center, No. 9, 1979.

Table 1. Result of test reeling (Centre) (1979)

No.	Locality	Shipping date	Race	Shipping amount of fresh cocoon (kg)	Length of cocoon filament (m)	Size of cocoon filament (d)	Reela-bility (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)	Eliminated cocoon (%)
1	Ubolrat	17 Jan.	K1xK8	597.6	1,108	1.5	84	15.57	17.89	89	28.69
		4, 8 March	K1xK8	688.3	957	1.5	97	15.01	19.10	78	16.19
		15 Oct.	–	1,110.4	1,117	1.8	91	15.62	20.08	78	22.95
		24 Nov.	–	771.6	–	–	–	–	22.25	–	16.12
		27 Dec.	–	994.2	741	1.9	91	14.32	18.27	78	19.06
2	Bangruad	1 Feb.	K1xK8	105.7	1,024	1.9	91	16.28	19.17	85	7.94
		8 June	K1xK8	283.7	1,166	1.7	94	15.33	19.57	78	9.70
		29 July	K1xK18, K18xK1	456.0	1,023	1.8	83	13.89	18.28	76	17.10
		17 Dec.	K8xK1	75.3	987	2.2	87	15.83	19.92	79	18.32
		29 Oct.	K1xK8	492.0	–	–	–	–	19.00	–	20.00
3	Lum Dom Yai	5 Feb.	K1xK8	140.7	1,005	2.0	89	15.07	19.29	78	9.19
		31 July	K1xK8	525.1	1,049	1.7	59	14.68	18.09	81	26.63
		29 Oct.	–	439.8	1,150	1.9	91	15.30	20.00	76	14.00
		20 Dec.	K1xK8	83.2	815	2.0	94	14.34	18.52	77	26.09
4	Karbcherng	5 Feb.	K1xK18	341.0	1,279	2.0	83	16.36	20.52	80	8.82
		4 June	N x C	124.5	1,584	2.6	58	18.99	24.70	77	13.31
		8 June	K1xK8	184.2	1,368	1.9	69	15.77	21.56	75	7.61
		16 July	C x N	313.5	1,323	2.8	46	16.54	23.02	72	47.30
		28 Aug.	K1xK8	322.4	1,274	1.9	80	14.05	19.09	73	25.76

Table 1 (Continued)

No.	Locality	Shipping date	Race	Shipping amount of fresh cocoon (kg)	Length of cocoon filament (m)	Size of cocoon filament (d)	Reela-bility (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)	Eliminated cocoon (%)
5	Chieng Pin	5 Feb.	K1xK8	102.2	1,057	1.8	90	15.54	20.04	77	6.49
		5 April	K1xK8	92.6	1,073	1.5	90	14.67	20.02	73	14.14
		8 June	K1xK8	403.4	1,062	1.6	65	13.16	19.11	69	19.79
		28 July	K1xK18, K18xK1	254.5	873	1.7	75	14.38	17.67	81	29.47
		30 Oct.	–	313.9	–	–	–	–	20.00	–	20.00
6	Lum Dom Noi	23 March	K1xK8	161.2	1,019	1.6	89	15.16	20.38	74	28.95
		8 June	K1xK8	167.0	1,195	1.8	86	14.98	20.13	74	16.61
		9 Sept.	N x C	203.6	1,347	2.1	68	16.27	21.60	75	19.01
		27 Oct.	K8xK1	468.5	–	–	–	–	20.00	–	40.00
		15 Dec.	K1xK8	131.0	870	1.7	94	14.38	19.53	75	32.59
7	Prasart	8 June	K1xK8	809.7	1,212	1.8	86	15.48	19.95	77	8.43
		27 July	K1xK8	617.9	1,019	1.8	81	15.89	18.79	85	11.96
		29 Nov.	K1xK8	277.2	940	1.7	94	14.55	18.40	79	14.24
8	Ponpisai	11 June	K1xK8	400.9	1,167	1.8	48	13 06	19.35	67	24.25
		5 Nov.	K1xK8, K18xK1	586.9	955	2.2	74	15.30	19.82	78	33.67
9	Kum Soi	11 June	K1xK8	753.5	1,151	1.9	74	14 02	19.80	71	27.17
		7 Sept.	N x C	546.3	1,021	2.5	72	15.76	20.37	75	31 65
		12,17 Sept.	N x C	770.0	1,251	2.4	55	16.89	22.24	76	29.22
		12 Dec.	–	689.8	841	1.9	86	13.72	20.88	67	20.35

Table 1 (Continued)

No.	Locality	Shipping date	Race	Shipping amount of fresh cocoon (kg)	Length of cocoon filament (m)	Size of cocoon filament (d)	Reela-bility (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)	Eliminated cocoon (%)
10	Kuchinarai	9 June	K8xK1	1,224.5	1,181	1.9	56	13.45	19.08	70	22.55
11	Lumpao	28 July	K18xK1, K1xK18	740.2	993	1.8	59	13.81	17.85	77	24.03
		1 Nov.	K18xK1	552.7	–	–	–	–	19.57	–	19.71
12	Num-oon	31 Aug	K1xK8	141.0	896	2.2	64	14.17	20.60	69	55.73
13	Prachinburi	11 Sept.	N x C	50.8	–	–	–	–	22.13	–	12.98
14	Pimai	28 Nov.	–	420.6	1,084	2.4	89	13.25	22.21	60	16.12
15	Udorn	29 May	K1xK8	41.3	–	–	–	–	20.11	–	12.17
16	Korat	9 July 79	K1xK8	8.2	–	–	–	–	20.48	–	44.90
(Total or average in 1979 (1978)				18,978.60 (6,910.60)	1,084 (1,113)	1.93 (2.09)	78.47 (71.56)	15.02 (15.30)	19.96 (20.59)	75.76 (74.22)	21.54 (13.08)

Table 2. Result of test reeling (company) (1979)

No	Locality	Shipping date	Race	Shipping amount of fresh cocoon (kg)	Length of cocoon filament (m)	Size of cocoon filament (d)	Reelability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)	Eliminated cocoon (%)
1	Ubolrat	9 June	K1xK8	1,020 8	–	–	–	–	18 98	–	23 95
		24 July	–	379.7	991	1 9	68	14 79	20 07	74	30 03
		21 Aug	K1xK8	858 2	1,155	1 7	70	13 66	18 46	74	24 80
		11 Sept	N x C	731 9	1,343	2 0	44	16 30	21 94	74	21.69
		4, 8 March	K1xK8	80 6	–	–	–	–	–	–	–
2.	Bangruad	10 Sept	N x C	396.1	1,044	2 1	63	17 42	22.98	76	15 44
3	Lum Dom Yai	11 Sept	N x C	270 7	1,269	2 4	62	17 20	22 82	75	13 32
		27 June	K1xK8	361 8	–	–	–	–	19 07	–	15 99
4.	Karbcherng	6 Nov	K1xK8	855 7	1,112	2.0	95	17.15	20 07	87	14.91
5	Chieng Pin	30 June	K8xK14	23 8	–	–	–	–	16 99	–	22.41
		15 Sept	–	275 7	1,276	2 3	72	18 07	22 01	82	21 68
6	Lum Dom Noi	25 July	K1xK8	241 4	1,117	1 6	77	14 99	18 15	88	32.26
		8 June	K1xK8	223 6	–	–	–	–	–	–	–
7	Prasart	5 Feb	K1xK8	304 0	1,004	1 7	96	15 70	19 51	79	9.82
		10 Sept	N x C	570 9	1,543	2.6	79	18 11	21.91	82	16 74
8	Pongpisai	2 Aug	K1xK8	615 8	1,208	1 7	55	14 41	19 10	76	29 07
		16 Sept	–	645.5	1,215	2.7	42	16 33	21 13	78	37 25
9	Kumsoi	2 Feb	K1xK8	332 2	754	1 5	87	13 44	16 70	78	18 13
		26 July	–	291 3	1,138	2 0	65	16 88	22 34	77	26 57
		3 Aug	K1xK8, K1xK18	510 4	1,147	1.7	77	14.14	19 07	74	37 45
		19 Oct.	–	1,631 1	827	2 6	81	16 43	20 00	82	25 00
10	Kuchinarai	2 Jan.	K1xK8	669 9	664	1 6	91	13 00	15 99	81	35 54
		14 Feb	K1xK8	454 3	833	1 6	88	13.89	17.07	81	29.90
		5 Aug	K1xK8	1,122.5	1 158	1 6	56	13 67	18.28	76	35 57
		14 Sept	–	709 8	–	–	–	–	23 04	–	34.96
		3 Nov.	–	1,547 3	993	1 9	90	13.74	19.03	72	22.52

Table 2 (Continued)

No.	Locality	Shipping date	Race	Shipping amount of fresh cocoon (kg)	Length of cocoon filament (m)	Size of cocoon filament (d)	Reela-bility (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)	Eliminated cocoon (%)
11	Lumpao	29 June	K1xK8	462.3	–	–	–	–	18.23	–	20 88
		14 Sept.	–	295.9	1,409	2.5	77	18 24	22.71	79	36.17
12.	Pimai	27 Sept.	–	943.8	–	–	–	–	22.75	–	29.45
13	Kabinburi	21 Aug.	–	192.3	968	2.2	94	14.76	20.99	78	25.52
14	Kuchinarai	23 Dec.	–	787.1	–	–	–	–	16 25	–	31.33
15.	Hua-Luang	23 Dec.	K1xK8	163.8	–	–	–	–	18.81	–	8 34
16.	Lumpao	24 Dec	K1xK8	185.5	–	–	–	–	18 47	–	13.54
17	Pongpisai	24 Dec.	K1xK8	201.0	–	–	–	–	19.76	–	12 82
18	Chieng Pin	25 Dec.	K1xK8	169 4	–	–	–	–	18.12	–	14.46
Total or average in 1979 (1978)				18,496.10 (13,707.60)	1,098 (1,029)	1.99 (2.01)	74.04 (72.19)	15.56 (14.32)	19.72 (20.15)	78.32 (72.89)	23 86 (10.91)

46. Survey on Relation Between Size of Raw Silk and Graduations on the Adjusting Scale Plate, Using a New Automatic Reeling Machine, KEINAN Type (2)

Kesato YAMAGUCHI, Saengchan KUN-OWN, and
Chanya PANNENGPET

Following the previous report (1), the experiment, using cocoons cooked in the same manner, was carried out to know relations between size of raw silk to have its uniformity and the graduations on the adjusting scale plate to be adjusted and inspected periodically, under different reeling velocities. Additionally, size detector and size adjusting apparatus, acting in cooperation with picking cocoon equipment, are the most important parts of the automatic reeling machine in order to maintain the proposed size of the thread throughout the reeling process.

In the experiment, cocoons used were different from last year's in size and surveys on reeling cocoon number per thread in the process of reeling were added.

MATERIAL AND METHOD

1. Cocoons used: 2.3d
2. Cocoon cooking: By cooking machine as usual
3. Cooking time: 10 minutes/lot
4. Reeling machine: Automatic reeling machine, KEINAN S-EB type
5. Reeling velocity: 150, 175, and 200 rounds/minute
6. Graduations on the adjusting scale plate to be arranged: +6, +4, +2, 0, −2, −4, −6
7. Target size: 21 d
8. Size test: 24 sizing skeins/lot
9. Reeling cocoon number: To be counted at the intervals of two minutes

Trials were at random carried out under the respective combinations of the reeling velocity at 3 levels and the graduations at 7 levels.

RESULT AND CONSIDERATION

Results are shown in Tables 1 – 2 and Figs. 1 – 3.

1-1. Reeling cocoon number per thread and its standard deviation by reeling velocity (Table 1, Fig. 1).

Reeling cocoon number per thread decreased at highly significant level as the graduations were moved to minus point and the reeling velocity was speeded up.

1-2. Size of raw silk and its standard deviation by reeling velocity (Table 2, Figs. 2 – 3).

Size of raw silk in average varied in the same manner as in the case of 1-1, showing the graduations to have their abilities to get the proposed size. The said relations are illustrated in Fig. 1.

2. Relations between size of raw silk and reeling cocoon number per thread with different reeling velocities were formulated and calculated highly significant as follows:

2-1. Regression

150 r/min. $Y = 8.1821 + 1.4329X$, $F(1.5, 0.01; 16.3) < F; 43.57)$

175 " $Y = 7\,6305 + 1.4409X$, $F($ " $) < F; 98.80)$

200 " $Y = 2.2613 + 2.2253X$, $F($ " $) < F; 41.65)$

X = Average reeling cocoon number per thread

Y = Size of raw silk

2-2. Correlation (r: correlation coefficient)

150 r/min. $r = 0.95$ $(t) = 9.500 > 4.032$, $t(5,0.01)$

175 " $r = 0.97$ $(t) = 12.5226 > 4.032$, $t(5,0.01)$

200 " $r = 0.94$ $(t) = 8.5824 > 4.032$, $t(5,0.01)$

From the results above mentioned, it is very important to use effectively the size adjusting apparatus to help accurately the performance of the detector by the use of cocoons with definite size. In addition, there are many factors which will give changeable effects to the proposed size of raw silk, so it is very necessary to pursue the interaction of cause and effect among the factors, followed by proper maintenance of the interested machines.

LITERATURE

(1) YAMAGUCHI, K, S. KUN-OWN, and C. PANNENGPET: Survey on relation between size of raw silk and graduations on the adjusting scale plate, using a new automatic reeling machine, KEINAN type. Bul. Thai Seri. Res. and Train. Centre. No. 9, 1979.

Table 1. Reeling cocoon number and its standard deviation by reeling velocity

a: Graduations b: Item c. Reeling velocity

c / b / a	150 r/min		175 r/min		200 r/min		Average		Analysis of variance
	C.N.	S.D.	C.N.	S.D.	C.N.	S.D.	C.N.	S.D.	
+6	8.82	0.85	8 59	0.97	8.02	0.97	8.44	0.93	Average cocoon number F(0.01)**
+4	8.62	0 68	8.43	0.77	7.75	0.80	8.43	0.75	
+2	8.65	0.75	8.08	0 80	7.44	0.82	8.22	0.79	
0	7.94	0 84	7.81	1.05	7.38	0.89	7.81	0 92	
−2	8.07	0.90	7.72	0.96	7.15	0.68	7.54	0.84	
−4	7.65	0 81	7.28	0.79	6 98	0.79	7.13	0.79	
−6	6.79	0.85	6.58	0 82	6.31	0.72	6.56	0.79	
Average	8.08	0.81	7.83	0.88	7.26	0.81	7.72	0.83	
Analysis of variance	Average cocoon number F (0.01)**								

Note: C.N. - Average cocoon number S.D. - Standard deviation

Table 2. Size of raw silk and its standard deviation by reeling velocity
(a, b, c, see Table 1)

c / b / a	150 r/min		175 r/min		200 r/min		Average		Analysis of variance
	S.	S.D.	S	S.D.	S.	S.D.	S.	S.D.	
+6	20.81	0.876	20.39	1.302	20.06	1.209	20.42	1.129	Size of raw silk F(0.01)**
+4	20.63	1.254	20.29	0.826	19.68	1 337	20.20	1.139	
+2	20.31	1 171	19.88	1.239	18.84	0.849	19.67	1 086	
0	20.28	1.157	18 80	0.988	18 35	1.385	19.14	1.176	
−2	19 46	0.940	18.31	1.169	18.06	0.995	18.61	1.034	
−4	19.00	1.268	17.72	1.109	17.16	0.866	17.96	1.081	
−6	17.80	1.095	16.97	0.764	16.79	1.207	17.18	1.022	
Average	19.76	1.109	18.82	1.085	18.42	1.121	19 00	1 105	
Analysis of variance	Size of raw silk F(0.01)**								

Note: S. size S.D.; Standard deviation

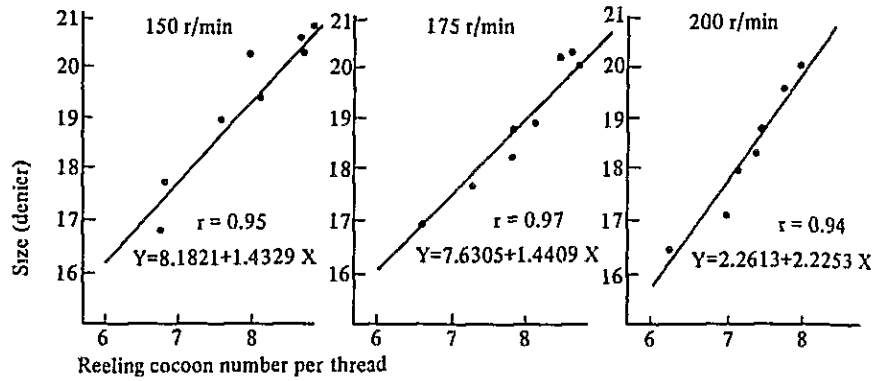

Fig. 1 Relations between size of raw silk and reeling cocoon number per thread

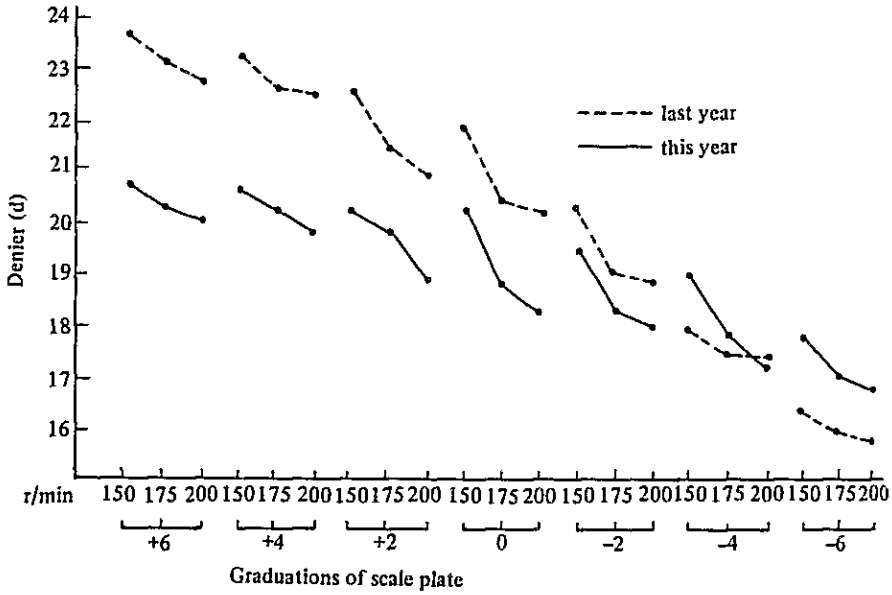

Fig. 2 Relations between size of raw silk and the graduations of scale plate

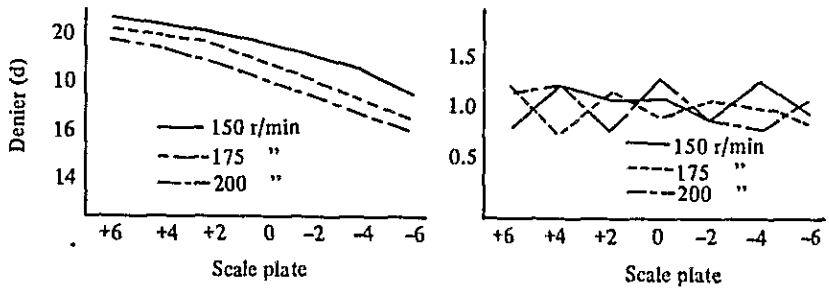

Fig. 3 Relations between size of raw silk and size deviation

47. Survey on Maintenance of Size detecter in the Process of Silk Reeling

Kesato YAMAGUCHI, Saengchan KUN-OWN, and
Vorapot RUKSUNG

The size detector is the most important part of the sutomatic reeling machine. The expected size of raw silk is dependable upon the normal function of the size detector. The authors tried to examine how to properly maintain size detector in the routine silk reeling work, taking up "dirtiness of size detector" as a serious subject among the factors concerned.

MATERIAL AND METHOD

1. Lot of test:
   a) Reeling cocoon number per thread to be surveyed every half day's reeling time.
   b) Reeling cocoon number per thread to be surveyed every day's reeling time.
   c) Reeling cocoon number per thread to be surveyed every two day's reeling time.
   d) Day to be reeled till adding the definite reeling cocoon number per thread to a cocoon.

   Note: The size detector is cleaned before starting of test.

2. Cocoons used: K_1 x K_8 and N x C with 2.2 deniers in size.

3. Cocoon cooking: By cooking machine as usual.

4. Reeling machine: Automatic reeling machine, KEINAN S-EB type.

5. Reeling velocity: 175 rounds/minute

6. Target size: 21 deniers

7. Temperature of reeling water: 40°C

8. Items of survey: Reeling cocoon number per thread and its standard deviation.

9 Reeling time: Half day – about 2 and half hours before and after noon, respectively.

RESULT AND CONSIDERATION

Results are shown in Tables 1 – 6.

1. Surveys on reeling cocoon number per thread in the test reeling before and after noon (Tables 1 and 2). Firstly, the survey was to know that the uniformly cooked cocoons would be supplied as materials for the test. As a result, the reeling cocoon number per thread proved significantly to be normally perceived by the size detector, showing the test cocoons cooked under the definite conditions.

2. Effect of cleanness of the size detector on reeling cocoon number per thread.

   2-1. There was no significant difference of reeling cocoon number per thread between the respective cleanness of the size detector before and after noon without its noticeable dirtiness (Table 3).

2-2. Reeling cocoon number per thread had a tendency to increase by 0.18 grains (0.40 deniers in the estimated size) after reeled for a day, compared with the cocoon number shortly after cleaned, though no statistically significant difference, in spite of the varying standard deviations, was noticeable (Table 4).

2-3. Reeling cocoon number per thread increased by 0.47 grains (1.03 deniers in the estimated size) after reeled for two days, compared with the cocoon number shortly after cleaned, though no statistically significant difference was found out (Table 5).

3. Day to be reeled till adding the definite reeling cocoon number per thread to a cocoon (Table 6).

The size detector, after cleaned, seemed to fail to function, sooner or later, within two or five days, showing coaser in size at the late period, compared with the size at the early period. The size increased by 2.2 deniers in five days after cleanness of the detector, if the detector remained as it was.

From the results above-mentioned, what is most important is to manage the size detector in the habit of cleanness. And, it is recommendable to cleanse the detector once a day at the end of daily reeling works.

Table 1. Reeling cocoon number per thread

No.	Before noon	Afternoon
1	8.83	9.09
2	8.50	8.90
3	9.80	8.80
4	8.60	8.35
5	8.05	7.55
6	8.95	9.07
7	8.30	8.40
8	8.53	9.30
9	8.45	9.15
10	9.75	8.50
11	8.80	7.95
12	8.10	8.73
13	8.45	8.90
$\bar{X}$	8.70	8.67

$Fo = 0.2527$

$Fo < F(1,24:0.05)$

Table 2. Reeling cocoon number per thread

No.	Date						
	a	b	c	d	e	f	g
1	8.40	9.80	8.60	8.05	8.95	8.65	8.30
2	8.90	8.80	8.35	8.55	9.07	8.62	8.65
3	8.45	9.75	8.80	8.57	8.10	8.05	8.45
4	9.15	8.50	8.95	7.95	8.73	8.35	8.90
5	9.10	8.10	8.75	9.05	9.00	8.65	8.75
6	8.80	8.80	8.71	8.45	9.00	8.62	9.65
$\bar{X}$	8.80	8.96	8.69	8.44	8.81	8.49	8.78

$F_0 = 1.2394$ $F_0 < F(6,35:0.05)$

Table 3. Reeling cocoon number per thread of every half day's reeling time

Shortly after cleaned		Ealf days after reeled	
C.N.	S.D.	C.N.	S.D.
8.83	0.761	9.09	0.944
8.50	0.946	8.90	0.912
9.80	0.768	8.80	1.026
8.60	0.598	8.35	0.669
8.95	0.686	9.07	0.593
8.30	0.657	8.40	0.580
8.05	1.050	7.55	0.605
$\bar{X}$ 8.70	$\bar{X}$ 0.781	$\bar{X}$ 8.63	$\bar{X}$ 0.761
S D. 0.573		S.D. 0.540	

$F_0 = 0.017$ $F_0 < F(1,12:0.05)$

C.N. . . . . Reeling cocoon number per thread
S.D. . . . . Standard deviation

Table 4. Reeling cocoon number per thread

Shortly after cleaned		A day after reeled	
C.N.	S.D.	C.N.	S.D.
8.53	0.886	9.30	0.571
8.45	0.887	9.15	0.587
8.80	1.056	7.95	0.589
8.10	0.827	8.73	0.884
8.57	0.870	7.95	0.592
8.45	0.759	8.90	0.641
$\bar{X}$ 8.48	$\bar{X}$ 0.881	$\bar{X}$ 8.66	$\bar{X}$ 0.552
S.D. 0.225		S.D. 0.540	

$F_0 = 0.4910$ $F_0 < F(1.10:0.05)$

Table 5. Reeling cocoon number per thread

Shortly after cleaned		A day after reeled		Two days after reeled	
C.N.	S.D.	C.N.	S.D.	C.N.	S.D.
8.51	1.032	8.60	0.754	8.80	0.801
8.10	0.308	8.80	0.951	8.71	0 845
9.05	0.759	8.45	0.686	9.00	1 000
8.65	0.999	8.62	0.855	9.65	0.745
$\bar{X}$ 8.57	$\bar{X}$ 0.775	$\bar{X}$ 8.61	$\bar{X}$ 0.812	$\bar{X}$ 9.04	$\bar{X}$ 0.848
S.D. 0.392		S.D. 0.143		S D. 0.424	

$F_0 = 3.1309$ $F_0 < F(3,12.0.05)$

Table 6. Reeling cocoon number per thread

Days till a cocoon added	Shortly after cleaned	A day after reeled	Two days after reeled	Three days after reeled	Four days after reeled	Five days after reeled
Two days	8.45	8.20	9.60	–	–	–
Five days	8.85	8.50	8.80	8.93	8.99	9 90

48. Survey on Cocoon Cooking for the Automatic Reeling Machine

Kesato YAMAGUCHI, Saengchan KUN-OWN, and
Vorapot RUKSUNG

By using an automatic reeling machine we can increase the efficiency of reeling process, cutdown the raw silk production cost, and increase the production of raw silk of high and uniform quality. For the purpose it is important to supply cocoons cooked under the fixed cooking conditions.

The experiment was carried out to find out the suitable cooking method to make cocoons fit for the automatic reeling machine, compared with the current cooking method.

MATERIAL AND METHOD

1 Cocoon used: K_1 x K_8 silkworm variety

2. Cocoon cooking: By CHIBA type cooking machine with intermittent system

Lot of test:	Control	Tested
Retting part	60°C	75°C
Steaming part for permeation	96°C	85°C
Low temperature saturation part	60°C	75°C
Steam cooking part	100°C	100°C
Steam pressure	10 mm	10 mm
Adjustment part	100 – 70°C	100 – 85°C
Finishing part	60°C	75°C

3. Cooking time: 8 minutes

4. Reeling machine: Automatic reeling machine, KEINAN S-EB type

5. Reeling velocity: 175 rounds/minute

6. Target size: 21 deniers

7. Size test: 40 sizing skeins/lot

8. Items surveyed: Reeling cocoon number per thread and its deviation, size and its deviation, cocoons to be supplied, feeding and efficiency, reeling thread trouble, grouping and efficiency, raw silk percentage, BUKAKE (raw silk percentage of cocoon shell), KIBISO (a kind of by-product silk) and BISU (a kind of by-product silk) percentages.

RESULT AND CONSIDERATION

Results are shown in Tables 1 – 4.

1. According to the sampling survey on the cocoon shell layer of cocoons used, prior to the experiment, some 11% of the cocoons had the double layered cocoon shells, especially in the inner part.

2. In the process of sending correct end cocoons to the supplier, the "Tested" plot with the cocoons cooked harder than "Control" showed that the cocoon in the waiting box had appeared at a higher frequency. And, there was little difference between the times to help the supply of cocoon in the continuous feeding end by the checking work of the size detector (Tables 1 – 2).

3. The groping end efficiency in both lots was almost the same, with 88%. The ratio of the continuous feeding end was slightly lower in the "Tested". The thread troubles, closely related to the efficiency of automatic reeling machine, occurred less in the "Tested". Further, the "Tested" showed less deviation of reeling cocoon number per thread and raw silk size in the reeling process (Table 2).

4. The raw silk percentage and BUKAKE (raw silk percentage of cocoon shell) resulted in better scores in the "Control" than the "Tested". In the "Tested", the rate of out-side waste silk (KIBISO) decreased in spite of an increasing rate of BISU, causing less raw silk percentage than that of the "Control".

From the results it may be recommended that the cocoons are to be cooked rather harder in the cooking process for the automatic reeling machine, though an increase in the raw silk percentage and BUKAKE remained to be unsolved.

Table 1. Frequency of spoon box having cocoons to be fed

Item \ Lot	Control	Tested
0 box having no cocoon	6	16
1 box having no cocoon	13	14
2 boxes having no cocoon	15	6
3 boxes having no cocoon	7	1
4 boxes having no cocoon	0	0
No. of box in average	1.56	0.84
Standard deviation	0.95	0.74
No. of box observed	41	37

Table 2. Times to help the supply of cocoon in the continuous feeding end

No. of feeding ends for picking one cocoon \ Lot	Control	Tested
1	33	38
2	9	8
3	8	7
4	3	4
5	1	1
Time in average	1.70	1.66
Standard deviation	1.04	1.05
No. of observation	54	58

Table 3. Reeling results

Item / Lot	Feeding end efficiency (%)	Occurrence ratio of reeling thread trouble /10,000 meter	Reeling cocoon number	Standard deviation of reeling cocoon number	Average size (d)	Size deviation (d)
Control	88.29	32.5	10.90	0.75	20.67	1.17
Tested	88.04	26.4	10.99	0.61	20.88	1.04

Table 4. Reeling results

Item / Lot	Raw silk percentage (%)	Out-side waste silk (%)	In-side waste silk (%)	Raw silk percentage of cocoon shell (%)
Control	39.04	5.33	7.08	75.46
Tested	38.83	4.75	10.73	75.07

Remarks: 1. Raw silk percentage: $\frac{\text{Cocoon filament}}{\text{dried cocoon shell}} \times 100$

2. Out-side, in-side waste silk, and raw silk percentage of cocoon shell were calculated from cocoon shell ratio.

49. Effect of Reeling Bath Temperature on the Function of Size Detector in the Automatic Reeling Process

Kesato YAMAGUCHI, Konthawirat CHOMCHUEN
and Chanya PANNENGPET

In the reeling process of the automatic reeling machine it is essential to be reeled under such fixed conditions as (1) reeling bath temperature, (2) reeling velocity, and (3) cocoon cooking. These factors are closely related to set the size detector, the most important part of the automatic reeling machine to work effectively.

The experiment was started to know the relation between the reeling bath temperature and the working of the size detector.

MATERIAL AND METHOD

1.	Cocoon used	:	Cocoons with 2.23 deniers in size
2.	Cocoon cooking	:	By cooking machine as usual
3.	Reeling machine	:	Automatic reeling machine, KEINAN S-EB type
4.	Reeling velocity	:	175 reounds/minute
5.	Time of reeling	:	60 minutes/lot
6.	Temperature of water in reeling basin	-	27°C (normal temperature), 40°C, and 50°C
7.	Target size	:	21 deniers
8.	Number of reeling threads	:	40 threads

RESULTS AND CONSIDERATION

Results are shown in Table 1 and Fig. 1.

The results of reeling cocoon number per thread by different reeling bath temperatures (Table 1) showed that the reeling cocoon number per thread increased with the rising reeling bath temperatures. These trends were noticeable when, compared with the lot of 40°C as the standard, the raw silk in size became finer by 0.27 deniers (the rate of reduction, 1.34%) in the lot of 27°C and became coarser by 0.69 deniers (the rate of increase, 3.37%) in the lot of 50°C, though the reeling cocoon number per thread among three treatments might not be subject to fluctuations in their standard deviations. Consequently, it may be noticed that the different reeling bath temperatures would cause to change the objective size by their degrees to be operated. We could see that the size detector might work to make the raw silk coarser in the case of higher temperature (50°C) and to make it finer in the case of lower temperature (27°C), though the effect of the difference between 50°C and 40°C was fairly different from that of 40°C and 27°C (Fig. 1).

As a result, it may be emphasized that the reeling bath temperature to give raw silk the fixed size to bear is to be uniformly managed throughout the reeling process, if necessary, with water supplier to be properly adjusted to have the uniform temperature.

Table 1. Raw silk reeling results by the different reeling bath temperatures

Treatment	Reeling cocoon number		Size (d)	Remarks
	Average	Standard deviations		
Reeling bath temperature				
27°C	9.06	1.047	20.20	
40°C	9.18	1.061	20.47	
50°C	9.49	1.054	21.16	

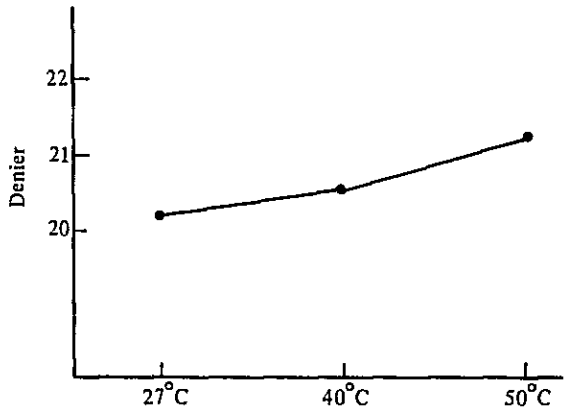

Fig. 1. Relation between reeling bath temperature and raw silk size to be estimated

50. A Survey on the Yield of Planting Group of Mulberry Trees

Preecha TAENGPEW* and Songrak TENGRATANAPRASERT*

A survey on the planting group of mulberry tree has started in Ubon Sericultural Experiment Station, where have been lacking in soil fertility and having many mulberry trees damaged by root rot. The aim of this survey is to know mulberry yields and vitality of trees under the given conditions.

MATERIALS AND METHOD

1. Area and variety tested : 1 rai, and mulberry variety, Noi
2. Space of planting : YOSEUNE type with the planting density as described in Fig. 1.
3. Number of tree per rai : 2,871 plants (261 per ridge)
4. Time of planting : June 1st, 1979
5. Training and harvesting

   Training : Low cut, 50 cm high from the base

   1st year :
   - Oct. : leaf picking
   - Nov. : low cut
   - Jan. : leaf picking
   - March : leaf picking
   - June : middle cut
   - Sept.: : shoot cutting, leaving a current shoot on each old shoot.

   2nd year : Base cut in Nov., harvested as usual.

6. Mannuring : 5,000 kg of compost was given in June

   Chemical fertilizer (15:8:10) : in Nov., March, and June, divided in three equal parts.

7. Items of survey

   1. Total amount of yield, number of shoots, length of the shoot at the harvesting time.
   2. Number of weakened and dead trees are counted.

* Ubol Racha Thani Sericultural Experiment Station

RESULT AND CONSIDERATION

The results in the first year are shown in Tables 1 and 2.

Unfortunately, the yield of mulberry leaves in the second harvesting was so small because of damages by root rot and mulberry thrips. This survey will be performed again in another field of 2 rais next year.

Table 1. Yield of mulberry leaves per rai

Month	Yield by leaf picking (kg/rai)
Nov. 1979	264
Feb. 1980	190

Table 2. Length and number of shoot and number of dead and incomplete tree

Month	Average length shoot	Number of shoot	Number of dead tree	Number of incomplete tree	Remarks
Nov.	201 cm	5	55	67	Damaged by root rot
Feb.	154	3	195	121	Damaged by root rot and thrips

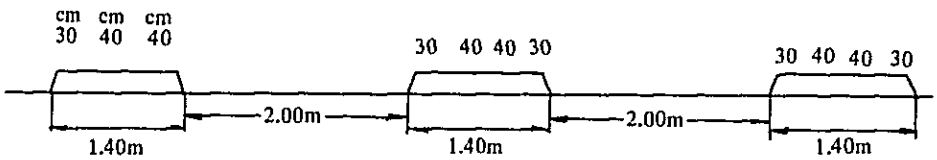

Fig. 1 Planting type (Y – mulberry tree)

51. A test on Efficient Separation of Moth for Laying Eggs

Suraporn CHAIAREE*, Suriya CHANSENGSRI*,
Preecha TAENGPEW*, Prayart TENGRATANAPRASERT*,
and Songrak TENGRATANAPRASERT*

This test was carried out to know the effects of color solution spraying to male moth before copulation on the efficiency of handling moths in the sex separation works.

MATERIAL AND METHOD

1. Silkworm race used : K_1 and K_8
2. Coloring matter used : Poster color and red ink
3. Sprayer
4. A timer
5. Number of moths tested : 200 copulates
6. Items of survey
   - 6.1 Vitality of male moth, kept at 25°C after color spraying
   - 6.2 Time for separation
   - 6.3 To ascertain whether separation is correct or not
   - 6.4 Number of fertilized and unfertilized eggs

RESULT AND CONSIDERATION

The results are shown in Tables 1, 2, and 3. The color, sprayed on male moth, seemed to be not bad for physiology of moths. The male moths sprayed by red ink were easily and conveniently separated. Accordingly, to use the color sprayed male moths in the egg production practice may be justified, if any effective color is applied to the discrimination between male and female moths with the same build.

Table 1. Number of daily dead male moth kept at 25°C after color spraying

Order of day / Plot	1	2	3	4	5	6	7	8	9	10	Total
Control	12	5	9	6	6	3	5	–	1	3	50
Red ink	10	10	8	5	6	3	2	3	2	1	50
Poster color	11	10	9	7	6	4	1	2	–	–	50

* Ubol Racha Thani Sericultural Experiment Station

Table 2. Time for separation (200 copulates)

Plot	Time		Number of male moth after separated
	Minute	Second	
Control	1	35	7
Red ink	1	18	–
Poster color	1	29	–

Table 3. Number of eggs laid (average of 10 batches)

Plot	Normal eggs	Non-fertilized eggs	Total
Control	361	47	408
Red ink	359	24	383
Poster color	385	17	402

52. Survey on the Amount of Leaves Supplied to Parent Silkworms in Ubol Racha Thani Sericultural Experiment Station

Supraporn CHAIAREE, Prayart TENGRATANAPRASERT,
Preecha TAENGPEW, and Songrak TENGRATANAPRASERT

In order to make a plan of rearing parent silkworms for silkworm egg production, the exact quantity of mulberry leaves required for the rearing amount of parent silkworms must be prepared in advance.

For the purpose, to know the amount of leaves supplied to a unit batch of parent silkworms in the Station the survey was carried out.

MATERIALS AND METHOD

1. Silkworm race : K_1 and K_8 (Received from the Centre)

2. Rearing season and number of batches reared were as follows:

Rearing Season	Number of batches reared	
	K_1	K_8
Jan. 1979	22	26
May 1979	21	40
Aug. 1979	90	100
Oct. 1979	36	60
Total	169	226

RESULT AND CONSIDERATION

The results are shown in Table 1, showing that the total amount of mulberry leaves supplied to a batch of parent silkworms throughout their laval stages was some 9.4 kg in cases of K_1 and K_8. Addifinally, the amount showed no remarkable difference between our Station and the Centre (1), (2).

LITERATURE

(1) PECHMONT, P.: Survey on the amount of food for main silworm race in the Center. Bul. Thai, Seri, Res and Train. Center, No. 5, 1975.
(2) TENGRATANAPRASERT, S., D. HARNKITCHANURUK, and D. NOISOMBAT: Survey on the amount of food for main silkworm races in the Centre (3). Ibid. No. 7, 1977.

Table 1. Amount of leaves supplied per batch (kg), 1979

Race		K1				K8			
Season / Stage		Jan.	May	Aug.	Oct.	Jan.	May	Aug.	Oct.
		kg	kg	kg	kg	kg	kg	kg	kg
1	Mulberry leaves	0.04	0.055	0.022	0.035	0.042	0.030	0.031	0.041
	Ave temp. (°C)	26.3	29.2	29.0	26.4	26.1	29.5	28.5	26.2
	Hum. (%)	59	78	79	71	61	77	82	68
2	Mulberry leaves	0.09	0.115	0.091	0.090	0.094	0.078	0.107	0.148
	Ave. Temp. (°C)	26.7	28.5	27.5	26.0	26.4	28.5	27.0	26.1
	Hum. (%)	63	80	86	66	63	80	87	66
3	Mulberry leaves	0.226	0.295	0.32	0.60	0.265	0.258	0.355	0.501
	Ave. Temp. (°C)	26.4	28.2	27.0	26.0	26.4	28.2	27.0	25.7
	Hum. (%)	66	81	87	69	65	81	85	70
4	Mulberry leaves	1.086	0.923	1.276	1.55	1.094	1.076	1.261	1.54
	Ave. Temp. (°C)	25.2	29.6	29.0	25.3	25.7	29.6	29.0	25.5
	Hum. (%)	65	74	80	73	65	74	28	72
5	Mulberry leaves	8.736	7.0	7.633	7.59	7.79	7.70	7.91	7.3
	AVe. Temp. (°C)	26.9	28.6	29.0	26.4	26.1	28.6	28.0	26.6
	Hum. (%)	59	78	76	70	61	78	81	70
	Mulberry leaves (Total)	10.179	8.39	9.343	9.87	9.29	9.14	9.658	9.53
	Ave. Temp. (°C)	26.3	28.8	28.0	26.0	26.1	28.9	28.0	26.0
	Hum. (%) (average)	62	78	82	70	63	78	81	69
	Mulberry leaves, Average	9.446				9.405			

53. Survey on Cocoons of Silkworms Mounted in Cocooning Frames Covered with Different Materials

Suraporn CHAIAREE*, Prayart TENGRATANAPRASERT*,
Suriya CHANSENGSRI*, and Songrak TENGRATANAPRASERT*

After silkworms eat mulberry leaves sufficiently during the fifth stage, the silkgland inside body develops fully. The silkworm begins crawling to seek the place of cocooning. Finding an appropriate place for cocooning, the silkworm begins to spin silk fiber and makes its cocoon.

In this survey we picked up the matured silkworms into the plastic cocooning frame, and covered them with some materials such as old newspaper or net. The results are given as under

MATERIALS AND METHODS

1. Silkworm race : K_8
2. Plastic cocooning frame
3. Old newspaper
4. Net
5. Principle items to be observed were as follows:
    1) Number of cocooning frame
    2) Number of matured silkworm
    3) Number of good quality of cocoons
    4) Number of bad quality of cocoons such as inside and outside soiled cocoon, double cocoon, pierced cocoon, malformed cocoon, thin-end cocoon, cocoon with prints of cocooning frame, thin-shelled cocoon.
    5) Number of cocoon per 1 kg
    6) Whole cocoon weight
    7) Cocoon shell weight
    8) Cocoon shell ratio
    9) Temperature and humidity during mounting
6. Place and time

    Ubol Racha Thani Sericultural Experiment Station, August – October 1979

RESULT AND CONSIDERATION

From the Table it may be said that the parent silkworms, mounted on the plastic cocooning frame covered with old newspapers, seemed to result in slightly good cocoon crops, though silkworms for silk production are accustomed to mount without covering in order to keep good reelability of cocoons harvested.

* Ubol Racha Thani Sericultural Experiment Station

Table 1. Quality of cocoons Time of experiment

I: August 1979 II: Oct. 1979

Cover material	Number of cocooning frame	Time of experiment	Good cocoons %	Bad cocoon %	Total %	Number of cocoon 1 kg	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell ratio %	Average Temp. / Hum. (°C) (%)	
										I	II
Old newspaper	5	I	85.00	15.00	100	695	1.490	28.692	19.26	29.3/75	26.0/76
		II	92.24	7.76	100	689	1.435	29.071	20.26		
Not covered	5	I	80.30	19.70	100	710	1.436	27.071	18.90		
		II	90.72	9.28	100	701	1.432	28.603	19.97		
Net	5	I	89.00	11.00	100	696	1.451	26.977	18.59		
		II	92.72	7.28	100	700	1.475	29.255	19.83		

54. Effect of Water Sprinkling on the Roof of the Rearing Room

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Tammanoon CHOTCHAI*, and
Songrak TENGRATANAPRASERT*

In the day time the temperature inside the rearing room rises often over 30°C. Such environment is not comfortable for silkworms, sometimes resulting in bad crops. In this test we tried to avoid the high temperatures in the rearing room by water sprinkling on their roof.

MATERIALS AND METHODS

1. Rearing room : 250 batches rearing room
2. Silkworm race · K_1 and K_8
3. Electric pump
4. Sprinkler · three ways, 4 pieces
5. Thermometer
6. Water tank size : 1 cubic meter
7. Items to be surveyed
   1) Temperature and humidity in the rearing room
   2) Amount of water to be supplied during 8.00 – 16.30 o'clock
   3) Cocooning ratio and sound pupa ratio
   4) Quality of cocoons
8. Place and time – Ubol Racha Thani Sericultural Experiment Station, Oct. 1979

RESULT AND CONSIDERATION

The results are shown in Tables 1 and 2.

Amount of water sprinkled on the roof of rearing room during eight and half hours was 17 cubic meter, supplied by circulating system.

In the afternoon, the indoor temperature of the rearing room by water sprinkling was occasionally lowered about 6°C against natural temperature. The cocooning ratio, sound pupa ratio, and the quality of cocoons were not bad. So, if water supply is profitable, we can give the comfortable rearing environments to silkworms in the hot season.

* Ubol Racha Thani Sericultural Experiment Station

Table 1. Comparison of temperature and humidity during rearing season period in Oct. 1979

Order of day	Rearing room, supplied water				Natural			
	Temp./humi. (°C/%)				Temp. /humi. (°C/%)			
	o'clock			Ave.	o'clock			Ave.
	06:00	11:00	16:00		Ave. 06:00	11:00	16:00	
1	24/81	26/66	27.5/60	25.8/63	25/75	29/67	32/26	28.7/66
2	24/72	26/66	27/57	25.6/66	25/79	29/65	30.5/57	28.1/67
3	23/71	26/58	28/64	25.7/64	24/77	27/67	29/63	26.6/69
4	23.5/72	27/62	28.5/63	26.3/66	23/76	27/67	30/63	26.6/68
5	24/72	26/66	29/60	26.3/66	24/77	28/64	30.5/60	27.5/67
6	24/72	26/69	28/60	26.3/67	23/72	28/68	31/66	27.3/69
7	24/76	27/88	28/60	26.3/68	24/67	27/77	30/63	27/69
8	24/72	26/73	27.5/70	25.8/72	24/73	27/72	30/43	27/69
9	23.5/76	25/77	28/67	25.5/73	22.5/81	27/69	29/78	26.2/76
10	23/85	25/73	27/59	25/72	24/76	25/77	27/69	25.3/74
11	24/81	25/81	26/82	25.0/81	23/80	25/71	31/59	26/70
12	23.5/76	26/73	28/60	25.8/70	22/80	25/70	31/52	26/67
13	23/80	26/69	28/67	25.7/72	24/84	27/67	31/53	27.3/69
14	23/80	26/73	28/67	25.7/73	24/75	27/66	30/52	27/64
15	24/76	25/65	28/60	25.6/67	23/83	25/65	31/52	27.3/67
16	24/81	26/78	28/60	26/84	24/84	28.5/75	29/58	27.1/72
17	24/81	27/59	28/53	26.3/64	24/75	28/79	29/65	27.0/73
18	24/81	27/62	28/60	26.3/68	25/84	29/79	31/52	28.3/72
19	25/81	28/67	30/68	27.7/72	25/84	29/75	31/52	28.3/70
20	25/81	28/67	29.5/64	27.5/71	25/76	29/77	31.5/62	28.5/71
21	25/81	28/67	30/68	27.7/72	25/84	29/75	31/52	28.3/70

Table 2. Results of rearing, 1979.

Season	Race	Cocooning ratio (%)	Sound pupa ratio (%)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Oct. 1979	K1	98.9	83.3	1.38	26.6	19.2
	K8	93.8	90.5	1.43	28.6	19.9