BULLETIN OF THE THAI SERICULTURAL RESEARCH AND TRAINING CENTRE

NO. 10

AUGUST 1980

THE THAI SERICULTURAL RESEARCH AND TRAINING CENTRE
KORAT, THAILAND

Japan International Cooperation Agency, Tokyo, Japan

BULLETIN OF THE THAI SERICULTURAL RESEARCH AND TRAINING CENTRE

NO. 10

AUGUST 1980

THE THAI SERICULTURAL RESEARCH AND TRAINING CENTRE
KORAT, THAILAND

Japan International Cooperation Agency, Tokyo, Japan

PREFACE

This report contains the results of surveys and researches pursued in the Centre in 1979, including the Ubol Racha Thani Station, under the guidance of our experts concerned. And, the contents of them were released and discussed in the annual research meeting in Korat (Nakorn Rachasima) on 19–20, March, 1980.

All researches as well as surveys may be available for the promotion of silk development in Thailand.

Additionally, our technical cooperation in the second year of the follow-up term from April, 1978 to March, 1980, mainly took active parts in the fields undermentioned. And, the technical cooperation during 11 years, 1969–1980, has been finished at the end of March, 1980.

The members of experts in this period were as follows:

Dr. Tashiro SUGIYAMA	:	Project Leader
Mr. Masashi RACHI	:	Silkworm egg production
Dr. Takashi ISHIJIMA	:	Disease and pest of silkworm and mulberry
Mr. Kesato YAMAGUCHI	:	Filature

30 August, 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

CONTENTS

1. Effect of Stock of Pai Variety on the Growth of Four Different Mulberry Varieties (4)

Nimit MUTTAMARA

From the results of mulberry variety test in the Centre, it has been found that the following mulberry varieties could be grouped into the high yield ones: Soi, Keaw Chonabod, and Tark. Noi variety with a good quality for silkworms is not in the same group, while it is well known among farmers. On the other hand, Pai variety, having a high resisting power to root rot disease, shows a low yield, with small and many-lobed leaves. If we can use Pai variety as a stock and another good variety as a scion to the budding, the resulting mulberry tree will be available in the sericultural practices. This experiment was started in 1976 (1) (2) (3).

MATERIAL AND METHOD

Experimental design	:	Latin Square method, 4 treatments (varieties), 4 replications
Varieties	:	1. Noi 2. Soi 3. Tark 4. Keaw Chonnabod
Area of a plot	:	11.25 m x 10.00 m
Density of planting	:	Inter-row 2.5 m, inter-tree 0.75 m
Time of planting	:	Pai variety to be used as stock was planted in June 1975 by cutting.
Time of bud-grafting	:	March 1976
Manuring	:	Compost 3,200 kg/rai; N-48 kg, P_2O_5–24 kg, and K_2O–32 kg per rai
Time of training and harvesting	:	March: Base cutting June: Middle cutting September: Shoot cutting December: Shoot cutting

RESULTS AND CONSIDERATION

The results statistically analysed are shown in Tables 1-5. The results showed that there were non-significant differences of yield as in the previous year, but seasonal differences of yield were statistically significant. Because there has been much rain in the 1st and 2nd harvesting season, while we have had less rain during the year with 553.8 mm than the average rainfall (about 1,000 mm).

LITERATURE

(1) MUTTAMARA, N: Variety test of mulberry trees by bud-grafting in the field (1). Bul. Thai Seri. Res. and Train. Centre, No. 7, 1977.
(2) MUTTAMARA, N.: Effect of stock of Pai variety on the growth of four different mulberry varieties (2). Ibid. No. 8, 1978.
(3) MUTTAMARA, N.: Ditto (3). Ibid. No. 9. 1979.

Table 1. Analysis of variance of length (cm) and number of shoots

S.V.	df	Mean square (F)	
		Number of shoot	Length
Total	47		
Row	3	24.4722 (5.03)	320.9444 (<1)
Column	3	9.4722 (1.95)ns	320.0556 (<1)
Variety	3	29.1944 (6.06)*	3,067.2222 (8.12)*
Error (a)	6	4.8611	377.7222
Time	2	7.5208 (4.15)*	4,765.7708 (28.76)**
Time x Var	6	5,1319 (2.83)*	263.9931 (1.59)ns
Error (b)	24	1.8125	165.7153
C.V. (a)% 14.5		14.5	13.3
C.V. (b)% 8.5		8.5	8.8

Table 2. Table of means

Varieties	Number of shoot				Length (cm)			
	Harvesting			Mean	Harvesting			Mean
	1	2	3		1	2	3	
Tark	15	16	14	15	170	147	126	148
Kaew Chonabod	13	14	15	14	179	163	138	160
Soi	15	15	15	15	160	156	143	153
Noi	16	17	20	18	146	113	111	123
Time-mean	15	16	16		164	145	130	

Table 3. Analysis of variance of yield (kg)

S.V.	df	Mean squares (F)	
		Yield/tree	Yield/rai
Total	47		
Row	3	0.0059 (<1)	19,075.81 (1.63)ns
Col	3	0.0070 (<1)	21,062.81 (1.80)ns
Varieties	3	0.0215 (2 44) ns	26,260.31 (2.25) ns
Error (a)	6	0.0088	11,690.53
Time	2	0.6844 (67.76)**	502,951.75 (75.80)**
Time x Var.	6	0.0197 (1.95) ns	12,317.72 (1.86) ns
Error (b)	24	0.0101	6,635.15
C.V.(a)% 16.9		16.9	26.0
C.V.(b)% 18.1		18.1	19.6

Table 4. Table of means

Varieties	Yield (kg/tree)				Yield (kg/rai)			
	Harvesting			Mean	Harvesting			Mean
	1	2	3		1	2	3	
Tark	0.69	0.56	0.26	0.50	533	400	141	358
Keaw Chonabod	0.82	0.59	0.27	0.56	631	415	184	410
Soi	0.68	0.60	0.39	0.56	547	431	290	423
Noi	0.71	0.74	0.38	0.61	576	564	276	472
Time-mean	0.73	0.62	0.33		572	453	223	

Comparison between time means, L.S.D. .05: 0.07
.01: 0.10

Comparison between time means, L.S.D. .05: 59
.01: 81

Table 5. Total yield per year

Varieties	kg/tree	kg/rai
Tark	1.51	1,074
Keaw Chonabod	1.68	1,230
Soi	1.67	1,268
Noi	1.83	1,416

2. Mulberry Variety Trial on Pai Variety Root-stocks (3)

Nimit MUTTAMARA

Now in Thailand, mulberry root rot disease is the most important to be protected. And no researcher has found how to control the disease by any chemical or cultivation methods. The mulberry varieties which are encouraged sericultural farmers to be distributed are Noi, Tadam etc. Though these varieties have high yield with good quality of leaves to raise silkworm, they are often damaged by root rot disease of mulberry. In the meantime, Pai variety has higher resistant power to the disease, with less amount of leaves, and more inferior nutritive value in the sericultural practices than the others. Therefore, we tried to compare the occurrence of damaged trees among three varieties, Noi and Tadam saplings, raised by bud-grafting into Pai stock, and Pai cutting inserted directly in the same infected field.

MATERIAL AND METHOD

Experimental design	:	Latin Square method, 3 treatments (varieties), 3 replications, 2 sets (Note: an additional set was started)
Varieties	:	1 Noi (Bud-grafting) 2 Tadam (Bud-grafting) 3 Pai (Direct cutting)
Area of a plot	:	(11.25 m x 10.00 m) x 2
Density of planting	:	Inter-row, 2.5 m, and inter-tree, 0.75 m
Time of planting	:	Pai variety was planted in June 1976 by cutting.
Time of bud-grafting	:	March 1977
Manuring	:	Compost 3,200 kg/rai, fertilizer N-48 kg, P_2O_5–24 kg, and K_2O–32 kg per rai.
Time of training and harvesting	:	March; Base cutting June; Middle cutting September; Shoot cutting December; Shoot cutting

RESULT AND CONSIDERATION

The regular survey was started in 1978.

From Table 1, the variatal differences of number and length of shoots were highly significant and significant, respectively. But in Table 3, yield of leaves were not statistically significant among treatments. The leaf yields in the second year was not satisfactory, caused by the damages from drought.

LITERATURE

(1) MUTTAMARA, N.: Mulberry variety trial on Pai variety root stocks. Bul. Thai Seri. Res. and Train. Centre, No. 8, 1978.
(2) MUTTAMARA, N.: Ditto, Ibid. No. 9, 1979.

Table 1. Analysis of variance of length and number of shoot

COMBINED ANOV

S.V.	df	Mean square (F)	
		Number of shoot	Length
Set	1	22.6851	8,970.666
Row/set	4	4.2408	572.4444
Col/set	4	3.6296	529.4444
Variety	2	56.0741 (18.58)**	11,534.0000 (11.34)*
Var x set	2	2.7408 (<1)	2,272.6667 (2.23) ns
Error (a)	4	3.0186	1,017.1111
Time	2	106.9630 (47.15)**	52,642.0556 (255.48)**
Time x set	2	9.1852 (4.05)*	680.3889 (3.30) ns
Time x var	4	22.9074 (10.10)**	755.9722 (3.67)*
Time x var x set	4	6.5741 (2.90)*	512.3056 (2.49) ns
Error (b)	24	2.2685	206.0556

Table 2. Table of mean

Varieties	Number of shoot				Length (cm)			
	Harvesting			Mean	Harvesting			Mean
	1	2	3		1	2	3	
Noi	12	16	17	15	215	111	123	150
Tadam	12	16	17	15	233	162	154	183
Pai	16	22	16	18	271	332	161	199
Time-mean	13	19	17		140	146	146	

Table 3. T Combined ANOV

S.V.	df	Mean square (F)	
		Yield/tree	Yield/rai
Set	1	0.4266	186,090.74
Row/set	4	0.0077	12,979.85
Col/set	4	0.0205	34,294.08
Variety	2	0.0534 (2.14) ns	112,986.35 (3.34) ns
Var x set	2	0.0086 (<1)	4,672.02 (<1)
Error (a)	4	0.0250	33,791.46
Time	2	1.9190 (220.57)**	1,564,542.13 (197.45)**
Time x set	2	0.0468 (5.37)*	16,534.69 (2.09)ns
Time x var	4	0.0213 (2.44) ns	28,422.77 (3.59)*
Time x var x set	4	0.0044 (<1)	1,513.55 (<1)
Error (b)	24	0.0087	7,923.80

Table 4. Table of mean

Varieties	Yield/tree				Yield/rai			
	Harvesting			Mean	Harvesting			Mean
	1	2	3		1	2	3	
Noi	0.93	0.64	0.19	0.59	769	503	69	447
Tadam	0.78	0.49	0.24	0.50	562	311	102	325
Pai	0.93	0.64	0.25	0.61	752	520	150	474
Time-mean	0.88	0.59	0.23		695	444	107	

3. Comparison of Mulberry Yield between 3 Times Harvesting and 4 Times Harvesting in a Year for Silkworm Rearing (2)

Manoch PANYAWANTCH and Nimit MUTTAMA

Now in the Centre, we harvest mulberry leaves from the same tree, 4 times a year. The tree under this harvesting method loses sometimes it's vitality earlier, caused by shortening its growing duration from one to another harvesting (1) (2) (3).

This experiment was started to know possible differences between 3 times and 4 times harvesting a year for silkworm rearing.

MATERIAL AND METHOD

1. Form of experiment : Randomized Complete block design, 5 treatments, 4 replications.
2. Varieties : Noi (scion), grafted May 1977 into Pai (stock), planted by cutting in June, 1978.
3. Area of a plot : 10.50 m x 10.00 m
4. Density of planting : Inter-row 2.5 m, inter-tree 0.75 m.
5. Manuring : Compost 3,200 kg/rai; Fertilizer: N–48 kg, P_2O_5–24 kg, and K_2O–32 kg per rai.
6. Time of training and harvesting : (On and after 1980)

Plot	Mar.	Apr.	June	July	Sept.	Oct.	Dec.	Jan.	Feb	Remarks
1	BC		BT		BM		(SC)		SC	4 times harvesting
2	BC		BT		BM		SC			3 times harvesting
3	BC	SA	BM		(SC)		SC			"
4	BC	SA	BM		SC		SC			"
5	BC	SA		BM		(SC)		SC		"

Note:
- BC: Base cut
- SA: Many current young shoots (about 3 cm in length) growing after base-cut are arranged by thinning, remaining 15 – 16 well grown ones.
- BT: About 1/3 of shoots, including dwarf and drooping ones, are thinned out at the base.
- BM: Middle cut, shoots are pruned about 1 m in height from the base.
- (SC): Regenerated shootlets after middle cut are pruned, remaining one shootlet on the old shoot
- SC: Harvesting of shoots growing after (SC)

7. Item of survey;

(1) Amount of whole lot and leaves yield are measured every harvesting time.

(2) Survey of growth : Number of the current shoots per tree and the longest one of them are surveyed.

(3) Survey of vitality : Healthy, depauperated, and dead trees before harvesting are counted.

RESULT

The regular survey will start in 1980.

LITERATURE

(1) YANO, Y. and K. YAMAKAWA: Experiment on the method of harvesting shoots for 3 rearing seasons (1). Bul. Thai Seri. Res. and Train. Centre, No. 7, 1977.

(2) PANYAWANICH, M. and J. CHINCHIEM: Ditto. Ibid. No. 8, 1978.

(3) PANYAWANICHI, M. and N. MUTTAMARA: Comparison of mulberry yield between 3 times harvesting and 4 times harvesting in a year for silkworm rearing (1) Ibid. No. 9. 1979.

4. Comparison of Yields of Mulberry Trees Planted with Different Distance of Inter-row and Inter-tree (2)

Manoch PANYAWANICH and Nimit MUTTAMARA

Planting distance and number of trees per unit area have close relations with training method, maintenance by hand or machine, yield etc. In case of hand tractor or hand labor, the inter-row distance is made narrower.

The experiment aims to increase knowledge of some effects of the different planting space on vitality and yield of mulberry trees and to find out the proper number of trees for the man power cultivation (1) (2).

MATERIAL AND METHOD

1. Experimental desing : Factorial in R.C.B. 7 treatments, 4 replications.
2. Used area : 91.5 x 45.5 m
3. Area of a plot : 10.5 x 10.0 m
4. Density of planting :

Plot	Inter-row m	Inter-tree m	Tree/rai	Remarks
1	2.00	1.00	800	All works are done by means of man-power
2	2.00	0.75	1,060	
3	2.00	0.50	1,600	
4	1.50	1.00	1,066	
5	1.50	0.75	1,422	
6	1.50	0.50	2,133	
7	1.00	1.00	1,600	

5. Time of planting : Pai variety as stocks was planted in June, 1978 by cutting.
6. Time of budding : May 1979, used Noi as scions.
7. Manure/rai : Compost 3,200 kg, fertilizer (formula 15-8-10), 100 kgs.
8. Time of training and harvesting : March: Base cut
   June: Middle cut
   September: Shoot cut
   December: Shoot cut

RESULT

The experimental trees were prepared by bud-grafting and the regular survey will start in 1980.

LITERATURE

(1) CHINCHIEM, J. and B. HONGTHONGDAENG: An experiment on planting density of mulberry trees (3) Bul. Thai Seri. Res. and Train. Centre. No. 8, 1978

(2) CHINCHIEM, J. and N. MUTTAMARA: Comparison of yields of mulberry trees with different distance of inter-row and inter-tree (1) Ibid. No. 9, 1979.

5. Studies on Chemical Weed Control as Post-Emergence Herbicides in Mulberry Plantation

Nimit MUTTAMARA and Prasarn WONGSAROJ

Mulberry plantation for silkworm rearing, have a problem to week control. Because mulberry trees are to compete with weeds (possible hosts of disease and harmful insect) for nutriment, water, and sunlight, resulting in their poor growth. Therefore, we should have a proper system of weeding in mulberry field for good yield of leaves. We can use the chemical as a method of controlling weeds.

MATERIAL AND METHOD

Area of experiment : 1.5 rai (planted, a year ago)

Chemical : Paraquat, dalapon, 2, 4-D and glyphosate

Experiment design : Randomized Complete Block Design, 7 treatments, 4 replications.

No.	Treatment	Rate of a, i. (g/rai)
1.	check	–
2.	paraquat	240
3.	2, 4-D	160
4.	dalapon	640
5.	glyphosate	320
6.	paraquat +2, 4-D	160 + 80
7.	dalapon +2, 4-D	480 + 80

Area of a plot : 15 x 5 m

Time of treatment : September 1979 (late in the rainy season)

Harvesting : Shoot cutting, (one time only)

RESULT AND CONSIDERATION

1. Toxicity of all chemicals were low as seen in Table 1. All chemicals but 2, 4-D resulted in good weed control (Tables 3 and 4).

2. Control quality, most of chemicals are good for weed control except 2, 4-D cannot eradicate (Table 3-4).

3. Yield of leaves (Table 2) showed that the chemical might not give the damages to the growth of mulberry trees.

Table 1. Toxicity and ability of the chemicals

No.	Treatment	Rate of a, i. (g/rai)	Toxicity	Ability to eradicate
1.	Check	–	–	–
2.	Paraquat	240	1.5	4.5
3.	2, 4-D	160	1.5	2
4.	Dalapon	640	2.0	3.5
5.	Glyphosate	320	2.0	5
6.	Paraquate +2, 4-D	160 + 80	1.5	4.5
7.	Dalapon +2, 4-D	480 + 80	2.0	3.5

Toxicity 1–No toxic, 2–little, 3–medium, 4–very much, 5–die
Ability to eradicate 1–No, 2–little, 3–medium, 4–good, 5–very good

Table 2. Fresh and dry weight of weed and growth of mulberry tree

No.	Treatment	Rate of a,i. g/rai	Fresh weight (g/m^2)	Dry weight (g/m^2)	Number of shoot per tree	Length of shoot (cm)	Yield kg/tree	Yield kg/rai
1.	Check	–	1,401.66	408.33	7 a	23 c	0.06 b	29.4 c
2.	Paraquat	240	208.33	65.0	13 a	75 a	0.25 a	138.9 a
3.	2, 4-D	160	678.33	198.33	11 a	42 bc	0.12 ab	59.9 bc
4.	Dalapon	640	485.0	145.0	10 a	46 b	0.14 ab	100.0 abc
5.	Glyphosate	320	50.0	20.0	13 a	62 ab	0.20 ab	130.8 ab
6.	Paraquat +2, 4-D	160 + 80	278.33	76.66	10 a	60 ab	0.18 ab	105.7 abc
7.	Dalapon +2, 4-D	480 + 80	535.0	151.66	12 a	47 b	0.7 ab	98.2 abc
C.V. %					30	23.1	41.4	43.3

L.S.D. 5% a–b–c

Table 3. Kind of weed before treatment

1	*Cyperus rotundus* Linn.
2	*Dactyloteneum aegyptium* (L.) D. Beauv.
3	*Cynodon dactylon* (L.)Fers.
4	*Melochia corchorifolia* L.
5	*Digitaria Spp.*
6	*Choris barbata* Sw.
7	*Panicum repens* Linn.
8	*Trianthema portulacastrum* Linn.
9	*Pennesetum polystaxhyon* Schult.

Table 4. Weed 40 days hence (See Table 3)

No.	Treatment	Weed	Remarks
1	Check	1, 2, 3, 4, 5, 6, 7, 8, 9	
2	Paraquat	1, 3, 7	
3	2, 4-D	1, 2, 3, 5, 6, 7	
4	Dalapon	1, 7	
5	Glyphosate	3, 7	
6	Paraquat +2, 4-D	1, 3, 7	
7	Dalapon +2, 4-D	1, 2, 7	

6. The Amount of Mulberry Leaves Produced in the Centre from June 1979 to February 1980

Manoch PANYAWANICH

The amount of mulberry leaves produced in the Centre for rearing silkworm from June 1979 to February 1980 is shown in Table I. The yield of leaves was converted from the yield of shoots weight, measuring the ratio of leaves to weight in each season(1).

One method was practiced on harvesting for young silkworm by leaf picking only. Total amount of leaves were 1,899 kg. Yield of leaves for old silkworm were 3,966 kg and 12,022 kg by middle cutting, and shoot cutting, respectively (Table 1).

Yield of leaves per rai for young silkworm and old silkworm were shown in Table 2. And the amount of mulberry leaves consumed for silkworm rearing in the Centre were shown in Table 3.

During the period, we had such troubles as seasonal shortage of rainfall, and the damages of virus and root rot diseases.

LITERATURE

(1) PANYAWANICH, M.: The amount of mulberry leaves produced in the Centre Bul. Thai. Seri. Res. and Train. Centre No. 1 – No. 9, 1971 – 1979.

Table 1. Seasonal yield of mulberry (kg) 1979

Rearing season	For young silkworm (1st–3rd stage)		For old silkworm (4th–5th stage)	
	Harvesting method	Yield of leaf	Harvesting method	Yield of leaf
June 1979	Leaf picking	485	Middle cutting	3,966
August 1979	Leaf picking	450	Shoot cutting	3,469
October 1979	Leaf picking	493	Shoot cutting	4,116
January 1980	Leaf picking	471	Shoot cutting	4,437
Total	Leaf picking	1,899	Middle cutting Shoot cutting	3,966 12,022
Grand total		1,899		15,988

Table 2. Seasonal yield and harvesting method (leaf only, kg/rai)

Rearing seasonal	Young silkworm (1st – 3rd stage)		Old silkworm (4th – 5th stage)	
	Harvesting method	Yield, kg/rai	Harvesting metho	Yield, kg/rai
June 1979	Leaf picking	200	Middle cutting	511
August 1979	Leaf picking	207	Shoot cutting	397
October 1979	Leaf picking	172	Shoot cutting	312
January 1980	Leaf picking	200	Shoot cutting	332

Table 3. Yearly yield of leaves consumed for the total silkworks (kg) 1974 – 1979

1974		1975		1976		1977		1978		1979	
Yield		Yield		Yield		Yield		Yield		Yield	
Young silk-worm	Old silk-worm	Young silk-worm	Old silk-worm	Young silk-worm	Old silk-worm	Young silk-worm	Old silk-worm	Young silk-worm	Old silk-worm	Young silk-worm	Old silk-worm
1,864	20,008	2,269	18,442	2,121	19,558	1,567	16,352	1,574	16,606	1,899	15,988
21,872		20,711		21,679		17,919		18,180		17,887	

7. Meteorological Record in the Centre in 1979

Bhinai HONGTHONGDAENG

As the growth of mulberry is controlled by meteorological condition, its daily record has been kept in the Centre. The average of each 10 days will shown here.

Method of recording: All tools for the meteorological observation are set in the meteorogical field according to general rule.

The items of observation are air temperature, rainfall and water evaporation. Air temperature were recorded automatically.

1. Air temperature (Table 1)

The daily lowest temperature recorded was 14.0°C on 27th December, while the highest was 40.0°C on 21st, 31st March and 1st, 2nd, 3rd, 7th, 8th, and 9th April. The lowest temperature (16.8°C) in the 10 days of each month occurred in the second 10 days of December.

The range between the highest and lowest in month was wider in January while narrower in the wet season.

2. Rainfall (Table 1)

The total annual rainfall in the Centre was 553.8 mm. The highest monthly rainfall, 210.10 mm was found in September and the lowest, 2.5 mm was in November, while no rain in January, March, and December.

The whole amount of rainfall in this year was lower than those of last year (748.5 mm) and ordinary year. In addition, the shortage of rainfall in the wet season resulted in bad growth of mulberry to reduce rearing amounts of silkworms.

3. Evaporation

Evaporation was recorded for the whole year, showing the highest in March (9.9 mm/day) and the lowest in September 5.0 mm/day).

Table 1. Temperature, rainfall and evaporated water

Month	Temperature (°C)			Rainfall (mm)	Evaporated water (mm/day)		
	Average	Max.	Min.		Average	Max.	Min.
January	1. 28.9	34.3 (35.8)	22.7 (20.6)		6.1	7.1	4.2
	2. 28.1	34.4 (36.7)	23.6 (19.8)		6.4	7.0	5.0
	3. 29.2	33.2 (36.0)	20.2 (18.0)		7.9	9.5	5.6
Average or sum	28.7	34.0 (36.7)	22.2 (18.0)		6.8	9.5	4.2
February	1. 25.5	31.6 (35.0)	20.3 (17.4)	3.6	7.0	7.9	4.9
	2. 28.8	33.9 (36.8)	22.5 (21.4)	3.4	7.6	9.5	5.7
	3. 28.8	36.3 (37.5)	25.0 (19.5)		10.4	10.0	7.7
Average or sum	27.3	33.7 (37.5)	21.7 (17.4)	7.0	8.1	10.0	4.9
March	1. 39.1	37.0 (39.5)	22.0 (19.3)		9.8	10.7	9.1
	2. 31.1	37.9 (39.0)	23.8 (22.0)		9.4	11.6	8.1
	3. 31.6	38.6 (40.0)	25.2 (23.0)		10.6	13.0	7.1
Average or sum	33.9	37.8 (40.0)	23.7 (19.3)		9.9	13.0	7.1
April	1. 32.5	38.6 (40.0)	25.6 (23.7)		11.1	13.6	2.3
	2. 30.3	36.7 (39.5)	25.1 (24.0)	18.4	9.8	11.8	6.7
	3. 29.1	35.4 (35.7)	25.6 (24.7)		7.6	9.4	5.1
Average or sum	30.6	36.9 (40.0)	25.4 (23.7)	18.4	9.5	13.6	5.1
May	1. 30.1	35.7 (38.0)	26.4 (25.4)	19.4	7.7	9.6	6.2
	2. 30.0	34.8 (38.0)	26.5 (25.3)	34.5	7.6	11.3	2.6
	3. 29.6	33.9 (36.0)	26.0 (25.2)	47.1	6.9	10.2	3.4
Average or sum	29.9	34.8 (38.0)	26.3 (25.2)	101.0	7.4	11.3	2.6
June	1. 29.1	34.3 (35.7)	26.3 (25.7)	22.6	6.7	10.2	4.5
	2. 28.1	32.1 (34.6)	26.1 (25.5)	52.7	4.2	6.0	2.0
	3. 27.9	32.1 (34.0)	25.4 (25.0)	1.7	4.3	5.2	1.5
Average or sum	28.4	32.8 (35.7)	25.9 (25.0)	77.0	5.1	10.2	1.5
July	1. 28.9	33.9 (36.0)	25.4 (24.5)	14.0	7.3	9.2	2.1
	2. 29.8	36.0 (37.7)	25.3 (24.3)	16.9	8.6	11.3	5.0
	3. 29.2	34.8 (36.2)	25.1 (24.3)	12.9	7.6	10.0	5.0
Average or sum	29.3	34.9 (37.7)	25.3 (24.3)	43.8	7.8	11.3	2.1
August	1. 28.5	32.4 (36.8)	25.5 (23.9)	39.1	5.3	8.5	2.8
	2. 28.4	33.1 (34.7)	24.9 (24.4)	11.6	6.8	8.8	3.8
	3. 28.6	34.5 (37.0)	24.7 (23.0)	13.5	7.8	10.0	4.7
Average or sum	28.5	33.3 (37.0)	25.0 (23.0)	64.2	6.6	10.0	2.8

Month	Temperature (°C)			Rainfall (mm)	Evaporated water (mmYday)		
	Average	Max.	Max.		Average	Max.	Min.
September	1. 27.4	32.8 (34.3)	23.9 (23.0)	20.1	6.4	8.3	5.0
	2. 27.3	32.1 (35.0)	24.4 (23.6)	43.0	4.9	6.2	3.0
	3. 25.2	28.7 (34.0)	23.2 (21.7)	147.0	3.8	7.1	1.0
Average or sum	26.6	31.2 (35.0)	23.8 (21.7)	210.1	5.0	8.3	1.0
October	1. 25.7	30.2 (31.8)	21.9 (20.3)		7.0	8.1	6 4
	2. 24.9	30.9 (32 0)	20.3 (19.0)		7.9	8.7	7.3
	3. 25.9	30.7 (33.7)	22.0 (20.0)	29.8	6.2	8.7	4.7
Average or sum	25.5	30.6 (33.7)	21.4 (19.0)	29.8	7.0	8.7	4.7
November	1. 25.1	33.0 (32.0)	20.2 (18.7)		6.9	7.3	6.5
	2. 25.1	29.8 (32.7)	20.5 (18.0)	2.5	7.3	10.4	5.8
	3. 22.5	28.2 (31.2)	17.3 (14.7)		6.8	7.7	6.3
Average of sum	24.2	29.7 (32.7)	19.3 (14.7)	2.5	7.0	10.4	5.8
December	1. 23.7	29.8 (32.0)	17.7 (15.3)		6.7	8.0	6.0
	2. 23.0	29.7 (33.3)	16.8 (15.0)		5.8	6.9	5.2
	3. 22.2	30.8 (34.1)	17.8 (14.0)		6.4	7.1	5.5
Average or sum	23.0	30.1 (34.1)	17.4 (14.0)		6.3	8.0	5.2
Rainfall/year				553.8			

Note: 1, 2, 3 show the first, the second and the last ten days, respectively. The figures in ( ) show the highest and lowest in the 10 days.

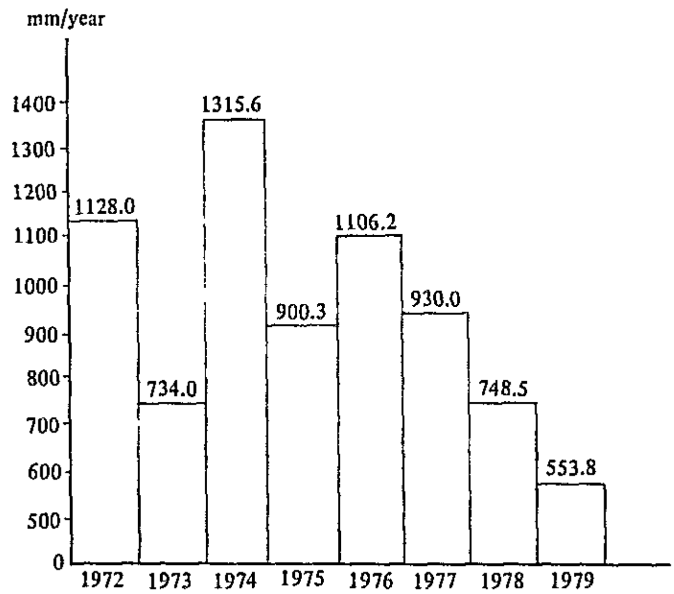

Fig. 1 The record of precipitation, 1972 – 1979

8. Study on Mulberry Variety for Silkworm Rearing

Wanchai SUKCHAROEN and Sompoti AKAPANTHU

There are many mulberry varieties such as Pai, Tark, KaewChonabod, Soi and Noi in Thailand. This experiment was carried out to know further the effect of mulberry varieties on the growth of silkworms and the quality of cocoons, though a few data on the subject have been reported (1), (2).

MATERIALS AND METHOD

1. Time of tests, and silkworm race and mulberry variety used.

   (1) August and October, 1978, and January and June, 1979
   (2) Silkworm race: K1 x K14
   (3) Mulberry variety: Pai, Tark, KaewChonabod, Soi, and Noi, supplied to the 5th stage.

2. Number of silkworm

   (1) Young stage: 1 g of newly hatch-larvae/replication
   (2) Old stage: 800 larvae (200 x 4 rep.)/treatment (variety)

3. Feeding

6:00 o'clock:	30% of daily supplied leaves
11:00 o'clock:	30% of daily supplied leaves
16:00 o'clock:	40% of daily supplied leaves

RESULT

Results are shown in Tables 1-8.

It may be summarized that Noi and KaewChonabod; Noi, KaewChonabod, and Tark; KaewChonabod and Tark; and Noi showed better results, in the respective rearing seasons of August, October, 1978, January, and June, 1979.

LITERATURE

(1) PLAENPUM P., and S. AKAPANTHU: Varietal effect of mulberry on the weight of cocoon and sound pupa ratio. Bul. Thai Seri. and Res. Centre No. 5. 1975.
(2) PECHMONT, P. and O. POCHAN: The nutritive difference for silkworms between two current mulberry varieties, Noi and Soi. Ibid, No. 7, 1977.

Table 1. Analysis of variance, August 1978

SV	df	Mean squares						
		Mounting number	Cocooning number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	25 5166	53.4000	43.6000	108.3333	0.0004	0.3500	0.0858
Treatment	4	11.5500 ns	27.7000 ns	135.8000*	4314.3750**	0.0934**	26.7187**	0.6757*
Error	12	8.5166	18.4000	32.7666	101.0416	0.0006	0.4437	0.1320
CV %		1.5	2.2	3.2	3.7	. 1.6	2.1	1.8

Table 2. Table of means, August 1978

Treatment	Mount-ing number	Cocoon-ing number	Sound cocoon number	Concoon weight (g)	Whole concoon weight (g)	Concoon shell weight (cg)	Concoon shell percent (%)
Pai	196 a	195 a	184 ab	248 c	1.41 d	29.5 c	20.9 ab
Tark	197 a	196 a	183 ab	270 b	1.53 c	32.1 b	21.0 a
Kaew Chonabod	198 a	197 a	188 a	306 a	1.66 b	33.6 a	20.2 b
Soi	194 a	191 a	176 b	228 c	1.36 e	28.8 c	21.0 a
Nois	194 a	192 a	174 b	296 a	1.72 a	34.8 a	20.2 b

Table 3. Analysis of variance, October 1978

SV	df	Mean squares						
		Mounting number	Cocooning number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	5.3500	7.0000	337.1166	893.3333	0.0012	1.7378	0.1605
Treatment	4	15.7000 ns	10.2500 ns	128.3000 ns	3056.2500*	0.0360*	6.2220*	0.5607 ns
Error	12	41.9000	7.4166	73.3666	670.4166	0.0082	1.3420	0.2384
CV %		0.9	1.4	5.0	8.1	4.8	2.1	2.6

Table 4. Table of means, October 1978

Treatment	Mount-ing number	Cocoon-ing number	Sound cocoon number	Cocoonı weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Pai	109 a	198 a	168 a	301 ab	1.79 b	34.2 b	19.2 a
Tark	199 a	199 a	172 a	331 ab	1.93 ab	35.6 ab	18.5 a
Kaew Chonabod	199 a	199 a	178 a	356 a	2.00 a	36.5 a	18.2 a
Soi	198 a	196 a	162 a	285 b	1.80 b	34.0 b	18.9 a
Noi	197 a	196 a	170 a	362 ab	1.95 ab	36.8 a	18.8 a

Table 5. Analysis of variance, January 1979

SV	df	Mean squares						
		Mounting number	Cocooning number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	17.7833	14.3166	50.1833	191.6666	0.0075	3.8791	0.0538
Treatment	4	10.6750 ns	10.6750 ns	85.5500 ns	964.3750**	0.0276**	6.3625**	0.6107 ns
Error	12	13.7416	15.1083	46.5166	138.5416	0.0009	0.5041	0.2084
CV %		1.9	2.0	3.8	4.1	1.9	2.1	2.2

Table 6. Table of means, January 1979

Treatment	Mount-ing number	Cocoon-ing number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Pai ,	194 a	194 a	170 a	271 bc	1.58 b	33.4 ab	21.1 a
Tark	197 a	196 a	181 a	296 ab	1.66 a	35.0 a	21.1 a
Kaew Chonabod	198 a	197 a	179 a	305 a	1.68 a	34.8 a	20.6 a
Soi	198 a	198 a	180 a	270 bc	1.48 c	32.3 b	21.8 a
Noi	198 a	198 a	182 a	280 b	1.53 bc	32.5 b	21.2 a

Table 7. Analysis of variance, June 1979

SV	df	Mean squares						
		Mounting number	Cocooning number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	3.0666	4.8666	6.4500	170.0000	0.0031	0.7178	0.0338
Treatment	4	19.3250**	10.3250*	129.9250*	708.1250**	0.0083*	2.7467*	0.0695 ns
Error	12	2.1916	2.6583	39.8250	110.6250	0.0025	0.7990	0.0405
CV %		0.7	0.8	3.7	3.8	3.1	2.7	0.9

Table 8. Table of means, June 1979

Treatment	Mount-ing number	Cocoon-ing number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Pai	197 a	197 a	175 a	285 a	1.62 ab	33.1 ab	20.4 a
Tark	193 b	194 b	159 b	252 b	1.59 b	32.4 b	20.3 a
Kaew Chonabod	198 a	199 a	170 a	271 a	1.58 b	31.9 b	20.2 a
Soi	196 a	197 a	166 ab	268 ab	1.61 b	33.0 ab	20.4 a
Noi	198 a	198 a	167 ab	284 a	1.69 a	34.1 a	20.1 a

9. Appropriate Time for Collecting Matured Silkworms

Wanchai SUKCHAROEN and Sompoti AKAPANTHU

Mounting technology to be improved for sericultural development in our country is very important, because farmers do not familiarize with bivoltine silkworm rearing. We tried to find out how to mount economically the matured silkworms.

MATERIALS AND METHOD

1. Time of test and silkworm race used: August – November, 1979, and K_1 x K_{18}

2. Number of silkworms

   1) Young stage: newly hatched larvae, 1g/replication
   2) Old stage: 800 lavae (200 x 4 rep.)/treatment
   3) Feeding
      6.00 o'clock: 30% of daily supplied leaves
      11.00 o'clock: 30% of daily supplied leaves
      16.00 o'clock: 40% of daily supplied leaves

3. Lot of test: Randonized complete with 5 treatments and 4 replications. Time for mounting was set by color appearance of sofg faeces discharged by matured silkworms as follows:

   1) Control: Picking matured worms with green faeces
   2) : Picking matured worms, after 6 hours from the time of 1)
   3) : Picking matured worms, after 12 hours from the time of 1)
   4) : Picking matured worms, after 18 hours from the time of 1)
   5) : Picking matured worms, after 24 hours from the time of 1)

RESULT

As shown in Tables 1 and 2, cocoon weight and cocoon shell weight in average in August rearing season, if matured worms are picked after 24 hours, were better, while cocoon shell percent was higher in the cases of picking-up at their stages of "green-faeces" and "after 6 hours". Meanwhile, in October rearing season, as shown in Tables 3 and 4, cocoon weight, cocoon shell weight, and cocoon shell percent showed better results in the lot of "after 24 hours".

Table 1. Analysis of variance, August 1979

SV	df	Mean squares					
		Mounting number	Cocooning number	Sound cocoon number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	3.6000	4.1833	8.5833	0.0004	0.1587	0.0152
Treatment	4	0.9250 ns	1.2000 ns	29.8000 ns	0.1006**	23.8758**	0.8308**
Error	12	5.3917	7.2000	25.8333	0.0007	0.1958	0.0281
CV %		1.1	1.3	2.6	1.5	1.2	0.8

Table 2. Table of means, August 1979

Treatment	Mount-ing number	Cocoon-ing number	Sound cocoon number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Control	199 a	198 a	195 a	1.53 e	31.30 e	20.32 a
After 6 hours	198 a	198 a	196 a	1.65 d	33.95 d	20.52 a
After 12 hours	198 a	197 a	194 a	1.75 c	35.00 c	19.97 b
After 18 hours	199 a	198 a	192 a	1.84 b	36.32 b	19.70 c
After 24 hours	198 a	198 a	189 a	1.94 a	37.72 a	19.40 d

Table 3. Analysis of variance, October 1979

SV	df	Mean squares					
		Mounting number	Cocooning number	Sound cocoon number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	4.8500	4.0500	237.3833	0.0002	0.1205	0.0213
Treatment	4	4.8250 ns	4.6250 (<1)	35.3250 ns (1.03)	0.0556** (126.99)	51.1030** (227.46)	4.0618** (161.93)
Error	12	3.0583	7.0917	34.2583	0.0004	0.2247	0 0251
CV %		0.8	1.3	3.2	1.5	1.8	0.8

Table 4. Table of means, October 1979

Treatment	Mounting number	Cocooning number	Sound cocoon number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Control	198 a	197 a	177 a	1.22 d	21.47 e	17.35 e
After 6 hours	197 a	196 a	178 a	1.25 d	22 52 d	17.92 d
After 12 hours	199 a	196 a	173 a	1.33 c	24.97 c	18.70 c
After 18 hours	198 a	198 a	181 a	1.42 b	27.72 b	19.50 b
After 24 hours	196 a	196 a	180 a	1.50 a	30.07 a	19.92 a

10. Experiment on Some Disinfectants of Silkworms to Replace Ceresan Lime

Wanchai SUKCHAROEN and Sompoti AKAPANTHU

The experiment was tried to find out other chemicals to replace 5% Ceresan lime, which has been recommended to be out of use in the sericultural practices owing to its harmful effect to human beings.

MATERIALS AND METHOD

1. Time of test and silkworm race used: August – November 1979, and K1 x K18

2. Number of silkworms

   1) Young stage: newly hatched larvae, 0.2 g/treatment
   2) Old stage: 200 larvae/treatment
   3) Time of feeding: 6.00, 11.00, 16.00 O'clock

3. Lot of test: Randomized complete blocks with 3 replications and 6 treatments

   1) Control
   2) Burn chaff
   3) Lime
   4) Chlorinated lime 2%
   5) Pafsol
   6) Ceresan 5%

RESULT

As shown in Tables 1, 2, 3 and 4, there might be no clear differences of the effects of the disinfecting materials on the growth of silkworms and the qualities of cocoons under the experimental conditions.

Table 1. Analysis of variance, August, 1979

SV	df	Mean squares					
		Mounting number	Cocooning number	Sound cocoon number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Treatment	5	1.8222 ns	1.6555 ns	21.9222 ns	0.0034*	2.1378**	0.0422 ns
Error	12	1.1111	1.1666	15.5555	0.0007	0.2628	0.0289
CV %		0.5	0.5	2.0	1.5	1.4	0.8

Table 2. Table of means, August, 1979

Treatment	Mounting number	Cocooning number	Sound cocoon number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Control	199 ab	199 a	196 a	1.77 a	37.23 a	21.00 a
Burn chaff	197 b	197 a	189 a	1.73 ab	36.46 a	21.03 a
Lime	199 ab	199 a	195 a	1.77 a	36.86 a	20.80 a
Chlorinated lime 2%	198 ab	198 a	192 a	1.78 a	37.33 a	20.93 a
Pafsol	198 ab	198 a	193 a	1.76 a	36.90 a	20.96 a
Ceresan 5%	200 a	199 a	196 a	1.69 b	35.03 b	20.73 a

Table 3. Analysis of variance, October, 1979

SV	df	Mean squares					
		Mounting number	Cocooing number	Sound cocoon number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Treatment	5	3.7888 ns (1.00)	5.1222 ns (1.49)	29.9555 ns (1.78)	0.0013 ns (2.41)	0.3858 ns (1.31)	0.0266 (<1)
Error	12	3.7777	3.4444	16.7777	0.0005	0.2955	0.1122
CV %		1.0	1.0	2.2	1.4	1.6	1.7

Table 4. Table of means, October, 1979

Treatment	Mounting number	Concooning number	Sound cocoon number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Control	199 a	198 a	181 b	1.73 a	34.67 a	20.00 a
Burn chaff	198 a	198 a	185 ab	1.71 a	34.10 a	19.93 a
Lime	196 b	196 b	181 b	1.73 a	34.30 a	19.80 a
Chlorinated lime 2%	199 a	198 a	186 ab	1.71 a	34.13 a	19.93 a
Pafsol	198 a	198 a	186 ab	1.73 a	34.27 a	19.77 a
Ceresan 5%	200 a	200 a	190 a	1.68 b	33.57 b	19.97 a

11. An Experiment on Silkworm Rearing with Different Parts of Mulberry shoots (2)

Theera NGARMPRASIT

The quality of mulberry leaves are different by their position on the branch (1). We tried to find out the most fitting leaves to increase the cocoon yield among their different order on branches in the practices of 5th instar silkworm rearing.

MATERIAL AND METHOD

1. Time of test : August 1978 – July 1979

2. Lot of test : RCB with 4 replications and 5 treatments (mulberry variety: Noi) are as follows:

    1) Upper and middle parts of branches
    2) Middle and lower parts of branches
    3) Lower parts of branches
    4) Middle parts of branches
    5) Upper, middle, and lower parts of branches

3. Silkworm race : K1 x K14

4. Number of silkorm

    1) Young stage: newly hatched larvae, 1g/replication.
    2) Old stage: 800 larvae (200 x 4 rep.)/treatment

5. Time of feeding and distributive ratio

    6.00o"clock : 30% of daily supplied leaves
    11.00 o'clock : 30% of daily supplied leaves
    16.00 o'clock : 40% of daily supplied leaves

RESULT

As shown in Tables 1, 2, 3, 4, 5, 6, 7, and 8, silkworms were not expected to harvest good cocoons, fed on only the lower parts of branches during the 5th instar silkworm rearing

LITERATURE

(1) PANNENGPET, P., S. AKAPANTHU and A. MUROGA: An experiment of silkworm rearing with different parts of mulberry shoots. Bul. Thai Seri. Res. and Train. Centre No. 9, 1979

Table 1. Analysis of variance, August, 1978

SV	df	Mounting number	Cocooning number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	4.3166	30.1833	95.5333	147.9166	0.0063	1.6500	0.0871
Treatment	4	23.6750 ns	185.0750**	52.7500**	929,3750**	0.0141**	6.7187**	0.1180 ns
Error	12	22.9416	22.8083	58.1166	155.2083	0.0015	0.8270	0.0813
CV %		2.5	2.6		4.8	2.6	3.1	1.4

Table 2. Table of means, August, 1978

Treatment	Mount-ing number /200	Cocoon-ing number /200	Sound cocoon number /200	Cocoon weight (g)/200	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Upper and middle part	195 a	192 a	175 a	275 a	1.48 ab	30.4 a	20.6 a
Middle and lower part	194 a	188 a	181 a	269 a	1.55 a	31.2 a	20.2 a
Lower part	189 a	175 b	171 a	235 b	1.40 ab	28.0 b	20.1 a
Middle part	194 a	189 a	178 a	259 a	1.49 a	30.2 a	20.3 a
Whole shoot	194 a	190 a	178 a	261 a	1.42 ab	28.9 ab	20.4 a

Table 3. Analysis of variance, October, 1978

SV	df	Mounting number	Cocooning number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	12.1833	46.8500	34.3166	54.5833	0.0020	0.8458	0.0018
Treatment	4	8 4250 ns	17.2000 ns	25.3750 ns	2651.2500**	0.0780	24.9500*	0.0945 ns
Error	12	29.8916	31.7666	38.6083	121.2500	0.0009	7.4000	0.0501
CV %		2.8	3.0	3.3	3.7 .	1.7	8.4	1.2

Table 4. Table of means, October, 1978

Treatment	Mounting number /200	Cocooning number /200	Sound cocoon number /200	Cocoon weight (g)/200	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Upper and middle part	192 a	188 a	186 a	322 a	1.89 a	35.0 a	18.5 a
Middle and lower part	194 a	192 a	186 a	296 a	1.66 c	31.2 ab	18 8 a
Lower part	194 a	188 a	188 a	258 b	1.52 a	28.5 b	18.8 a
Middle part	194 a	190 a	186 a	310 a	1.77 b	33.5 ab	18.9 a
Whole shoot	196 a	192 a	191 a	315 a	1.76 b	33.1 ab	18 9 a

Table 5. Analysis of variance, January, 1979

SV	df	Mounting number	Cocooning number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	39.5166	30.2666	33.6666	471.2500	0 0062	1.8792	0.1058
Treatment	4	14.0000	10.0000	11 4250	2101.8750	0.0832	31.8562	0.2662
		1	1	1	13.69**	92.5**	44.07**	4.88**
Error	12	37.1000	43.6000	51.2916	153.5416	0.0009	0.7229	0.0546
CV %		3.1	3.4	3.8	4.5	2.0	2.8	1.1

Table 6. Table of means, January, 1979

Treatment	Mounting number /200	Cocooning number /200	Sound cocoon number /200	Cocoon weight (g)/200	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Upper and middle part	196 a	193 a	190 a	300 a	1.67 a	34.0 a	20.4 ab
Middle and lower part	192 a	190 a	189 a	266 b	1.44 c	30.1 b	21.0 a
Lower part	193 a	192 a	192 a	241 bc	1.28 d	26.4 c	20.6 a
Middle part	196 a	194 a	190 a	290 ab	1.54 b	31.6 b	20 6 a
Whole shoot	194 a	190 a	187 a	281 ab	1.52 b	31.8 b	20.8 a

Table 7. Analysis of variance, June, 1979

SV	df	Mounting number	Cocooning number	Sound cocoon number	Cocoon weight (g)	Whole cocoon weight (cg)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	18.4500	13.2000	15.6500	85.0000	0.0010	0.4791	0.1480
Treatment	4	6.4250 ns	9.0500 ns	12.5750 ns	623.7500*	0.0167**	5.1062*	0.1057 ns
Error	12	13.8250	15.2833	18.2750	128.7500	0.0028	1.4895	0.2117
CV %		1.8	2.0	2.2	4.3	3.8	4.6	2.4

Table 8. Table of means, June, 1979

Treatment	Mounting number /200	Cocooning number /200	Sound cocoon number /200	Cocoon weight (g)/200	Whole cocoon weight (g)	Cocoon shell weght (cg)	Cocoon shell percent (%)
Upper and middle part	195 a	194 a	192 a	276 a	1.47 a	27.6 a	19.0 a
Middle and lower part	195 a	194 a	191 a	259 ab	1.39 a	26.1 ab	19.0 a
Lower part	188 a	197 a	195 a	241 b	1.29 b	24.5 b	19.1 a
Middle part	196 a	193 a	191 a	259 ab	1 40 a	26.2 ab	18.9 a
Whole shoot	196 a	194 a	191 a	262 a	1.39 a	26.6 a	19.3 a

12. Varietal and Seasonal Effects of Mulberry Leaves on the Growth of the 5th Instar Silkworm

Pornthip PECHMONT

In order to know the effect of mulberry varieties on the growth of silkworm and the quality of cocoons the experiment was carried out (1).

MATERIALS AND METHODS

1. Test season : June – July, 1979

2. Silkworm race : K1 x K14

3. Mulberry variety used : Noi, Soi, and Pai

4. Lots of test : Randomized complete block design with 6 replications and 3 treatments (varieties) was used as follows:

   Treatment 1: Rearing silkworms by Noi variety
   Treatment 2: Rearing silkworms by Soi variety
   Treatment 3: Rearing silkworms by Pai variety

5. Number of silkworms

Newly hatched silkworms of 0.5 grams were reared till the 3rd instar, mixed together, and 200 old silkworms with 6 replications per treatment were arranged.

6. Rearing method

Fed on the leaves of Noi variety until the 4th stage, the silkworms were divided into three treatments (Noi, Soi, and Pai) at the beginning of the 4th stage. The respective mulberry leaves, without petioles, of Noi, Soi, and Pai mulberry varieties were supplied to the silkworms immediately after the 4th ecdysis.

7. Items of survey

1) Dry weight percentage of leaves supplied: Fresh leaves of 30 grams were sampled every feeding-time during the 5th stage, and their dried weights were measured after dried at 90°C for 8 hours. Dry weight percentage was calculated from:

$$\frac{\text{weight of dried leaves}}{\text{weight of fresh leaves}} \times 100$$

2) Amount of leaves ingested, amount of leaves digested and amount of faeces: Each amount of leaves ingested and digested were calculated from the following equations, respectively, based on each dried quantity. (I) Amount of leaves ingested = amount of leaves supplied – amount of waste leaves. (II) Amount of leaves digested = amount of leaves ingested – amount of faeces. All of faeces on the old bed were collected just before the next feeding and weighed after drying. (III) Digestibilities of leaves were calculated from

$$\frac{\text{amount of leaves digested}}{\text{amount of leaves ingested}} \times 100$$

3) Daily body weight of silkworms

Each 200 silkworms per lot were weighed at 6:00 A.M. every day during the 5th stage.

4) Cocooning ratio and sound pupa ratio.

5) Cocoon weight, cocoon shell weight and cocoon shell percentage.

RESULT AND CONSIDERATION

The results are shown in Tables 1-3.

1. The body weight of 5th stage silkworm increased daily with a higher rate in Noi leaves than both Soi and Pai leaves with the same rate. The daily difference of body weight between Noi and the others was seen soon after the 2nd day (Table 1).

2. Both the amount of leaves ingested and digested of Noi leaves showed larger values. A similar tendency in the digestibilities could be seen seasonally in another experiment.

As a whole, it may be said that Noi variety surpassed slightly the others in nutritive qualities to silkworms.

LITERATURE

(1) PECHMONT, P. and O. POCHAN: The nutritive difference for silkworms between two current mulberry varieties, Noi and Soi. Bul. Thai Seri. Res. and Train. Centre, No. 7, 1977.

Table 1. Means of daily body weight of silkworm in the 5th stage (per larva), June, 1979

Date	Treatment		
	Noi (g)	Soi (g)	Pai (g)
24, June	0.62	0.56	0.54
25	0.92	0.80	0.78
26	1.40	1.20	1.22
27	2.04	1.70	1.64
28	2.5	2.22	2.07
29	2.97	2.76	2.69

C.V. (a): 4.7%, C.V. (b): 5.4%

Comparison between the means of one and the other treatment in the same date:
LSD. .05 = 0.10
.01 = 0.13

Comparison between the means of one and the other date in the same or different treatment:
LSD. .05 = 0.10
.01 = 0.13

Table 2. Means of eating characters of silkworms in the 5th stage per 200 larvae

Treatment	Amount of waste leaves (dry weight, g) (DMRT)	Amount of leaves ingested (dry weight, g) (DMRT)	Amount of faeces (dry weight, g) (DMRT)	Amount of leaves ingested (dry weight, g) (DMRT)	Digestibility (dry weight, %) (DMRT)
1. Noi	502.2 (a)	703.7 (a)	483.6 (a)	220.1 (a)	31.2 (a)
2. Soi	627.0 (b)	619.1 (c)	434.2 (c)	184.9 (b)	29.8 (ab)
3. Pai	689.5 (c)	641.1 (b)	462.7 (b)	178.4 (b)	27.8 (b)
CV %	2.4	2.3	2.8	8.1	6.4

Table 3. Means of several practical characters

Treatment	Mounting number (DMRT)	Cocooning number (DMRT)	Sound pupa number (DMRT)	Whole cocoon weight (g) (DMRT)	Cocoon shell weight (cg) (DMRT)	Cocoon shell percent (%) (DMRT)
1. Noi	198 (a)	194 (b)	192 (a)	1.42 (a)	26.69 (a)	18.7 (b)
2. Soi	199 (a)	196 (a)	194 (a)	1.28 (b)	24.71 (b)	19.2 (a)
3. Pai	198 (a)	195 (ab)	191 (a)	1.25 (c)	24.43 (d)	19.5 (a)
CV %	0.9	0.9	1.9	1.6	2.4	1.5

13. Varietal Test of Several F_1 Hybrids of Bivoltine Silkworm Races

Pornthip RECHMONT

There are several F_1 hybrids of bivoltine silkworm races which have been improved by Breeding Section in our Centre. We tried to single the silkworm race out of the current bivoltine ones in order to make a practical guide for the sericultural farmers.

MATERIAL AND METHOD

1) Test season : August, and October, 1978

2) Lot of test : Randomized complete block design with 4 replications and 5 treatments was used as follows:

Treatment 1: silkworm race, K1 x T
Treatment 2: silkworm race, K1 x K8
Treatment 3: silkworm race, K1 x K14
Treatment 4: silkworm race, K6 x K8
Treatment 5: silkworm race, K6 x K14

3) Rearing method : Shoot rearing, fed 3 times a day.

The ratio of mulberry leaves distributed to 3 feedings.

6:00 a.m. : 30 percent of whole daily amount
11:00 p.m. : 30 percent of whole daily amount
16:00 p.m. : 40 percent of whole daily amount

4) Number of silkworms :

1) Young stage, 2 batches/treatment (race)
2) Old stage, 200 larvae/treatment (race)

5) Items of survey.

1) Terms of the 4th and the 5th stages.
2) Viability
3) Whole cocoon weight
4) Cocoon shell weight
5) Cocoon shell ratio
6) Temperature and humidity.

RESULTS

The results are shown in Tables 1–2.

It may be recognized that throughout two rearing tests K6 x K14 variety was better than the other ones in the practical characters of silkworms, followed by K6 x K8.

Table 1. Means of several practical characters, August rearing season, 1978

Treatment	Mounting number (DMRT)	Cocooning number (DMRT)	Sound pupa number (DMRT)	Whole cocoon weight (g) (DMRT)	Cocoon shell weight (cg) (DMRT)	Cocoon shell ratio (%) (DMRT)
1. K1 x T	195 (b)	186 (b)	192 (a)	1.47 (cd)	30.1 (c)	20.5 (c)
2. K1 x K14	194 (a)	191 (ab)	183 (b)	1.52 (c)	32.4 (b)	21.2 (b)
3. K6 x K14	198 (a)	194 (a)	194 (a)	1.87 (a)	43.9 (a)	23.5 (a)
4. K1 x K8	198 (a)	195 (a)	190 (ab)	1.42 (d)	30.9 (c)	21.6 (b)
5. K6 x K8	196 (a)	192 (ab)	189 (ab)	1.80 (b)	43.2 (a)	24.0 (a)
CV %	1.6	2.0	2.7	2.1	2.6	1.8

Table 2. Means of several practical characters, October rearing season, 1978

Treatment	Mounting number (DMRT)	Cocooning number (DMRT)	Sound pupa number (DMRT)	Whole cocoon weight (g) (DMRT)	Cocoon shell weight (cg) (DMRT)	Cocoon shell ratio (%) (DMRT)
1. K1 x T	197 (a)	193 (a)	192 (a)	1.84 (c)	32.8 (c)	17.8 (c)
2. K1 x K14	194 (a)	190 (a)	160 (c)	1.86 (c)	35.6 (b)	19.1 (b)
3. K1 x K8	194 (a)	191 (a)	177 (b)	1.81 (c)	35.6 (b)	19.7 (b)
4. K6 x K8	197 (a)	190 (a)	193 (a)	1.98 (b)	43.5 (a)	21.9 (a)
5. K6 x K14	196 (a)	191 (a)	187 (ab)	2.10 (a)	45.4 (a)	21.6 (a)
CV %	1.7	2.4	3.8	3.3	3.2	2.1

14. Silkworm Rearing by using the Silkworm Eggs Differently Treated by Artificial Hatching Method

Porntip PECHMONG

Using the eggs which were treated by different artificial hatching methods, the author tried to know the difference of practical characters among them.

MATERIAL AND METHOD

1. Test season : January-February, 1979

2. Silkworm race : K1 x K14

3. Mulberry variety used : Noi

4. Lot of test : Randomized complete block design with 3 replications and 6 treatments was used as follows:

   Treatment 1: Eggs by common acid-treatment
   Treatment 2: Eggs by common acid-treatment, hatched before 4 days from treatment 1
   Treatment 3: Eggs by acid-treatment after chilling.
   Treatment 4: Eggs by acid-treatment, hatched before 2 days from treatment 3.
   Treatment 5: Eggs by artificial hibernation.
   Treatment 6: Eggs by artificial hibernation, hatched before 2 days of treatment 5.

5. Rearing method : Shoot rearing, fed 3 times a day

6. Number of silkworms

   1) Young stage: 600 larvae/treatment
   2) Old stage : 450 (150 larvae x 3 rep.)/treatment

7. Item of survey

   1) Terms of the 4th and the 5th stages
   2) Viability
   3) Whole cocoon weight
   4) Cocoon shell weight
   5) Cocoon shell percentage
   6) Temperature and humidity

RESULTS

The results are shown in Table 1.

The differences in the growth of the silkworms were hardly found out among the treatments, though the quantitive characters in the "common acid-treatment" showed slightly lower results than those of the others.

Table 1. Means of several practical characters February 1979

Treatment	Mounting number DMRT	Cocooning number DMRT	Sound pupa number DMRT	Whole cocoon weight (g) DMRT	Cocoon shell weight (cg) DMRT	Cocoon shell ratio (%) DMRT
1. Common acid-treatment	148 a	143 a	143 a	1.30 c	27.7 c	21.3 a
2. Common acid-treatment, hatched before 4 days	147 a	145 a	142 a	1.50 b	32.0 b	21.3 a
3. Acid treatment after chilling	148 a	146 a	141 a	1.56 ab	34.0 a	21.8 a
4. Acid treatment after chilling, hatched before 2 days	148 a	147 a	145 a	1.57 a	34.7 a	22.0 a
5. Artificial hibernation	147 a	144 a	139 a	1.58 a	34.3 a	21.6 a
6. Artificial hibernation, hatched before 2 days	146 a	143 a	143 a	1.57 a	34.0 a	21.6 a
CV %	1.4	2.0	2.1	2.2	2.0	2.1

15. Silkworm Rearing by Using the Silkworm Eggs Treated by Different Dipping Time in the Acid Treatment Shortly after Laid

Pornthip RECHMONT

Using the eggs which were treated by different dipping time in the acid treatment shortly after laid, the surveys on the growth and productivity of the silkworms were carried out.

MATERIAL AND METHOD

1. Test season : August, and October, 1978
2. Silkworm race : K1 x K14
3. Mulberry variety used : Noi
4. Lot of test : Randomized complete block design with 4 replications and 5 treatments was used as follows:

Treatment	HCl solution used		
	Specific gravity	Temperature	Dipping time
1	1.12 at 15°C	30°C	10 min.
2	"	"	15
3	"	"	20
4	"	"	25
5	"	"	30

5. Rearing method : Shoot rearing, fed 3 times a day
6. Number of silkworms
   1) Young stage: 2 batches/treatment
   2) Old stage : 800 (200 larvae x 4 rep./treatment)
7. Items of survey
   1) Terms of the 4th and the 5th stages
   2) Viability
   3) Whole cocoon weight
   4) Cocoon shell weight
   5) Cocoon shell percentage
   6) Temperature and humidity during rearing

RESULT

The results are shown in Tables 1 – 2.

In both August and October rearing season, according to the statistically examined results, the differences among the treatments could be hardly recognized in the growth of silkworms and quantity of cocoons.

Table 1. Means of several practical characters, August 1978

Treatment	Mounting number DMRT	Cocooning number DMRT	Sound pupa number DMRT	Whole cocoon weight (g) DMRT	Cocoon shell weight (cg) DMRT	Cocoon shell ratio (%) DMRT
1. Duration in dipping, 10 min.	194 a	190 a	180 a	1.53 a	33.4 a	21.8 a
2. Duration in dipping, 15 min.	195 a	189 a	177 a	1.55 a	32.9 a	21.2 ab
3. Duration in dipping, 20 min.	198 a	194 a	178 a	1.54 a	33.2 a	21.5 ab
4. Duration in dipping, 25 min.	198 a	194 a	188 a	1.57 a	33.5 a	21.2 ab
5. Duration in dipping, 30 min.	198 a	194 a	183 a	1.58 a	32.9 a	20.8 b
CV %	1.8	2.1	5.4	2.4	3.7	2.5

Table 2. Means of several practical characters, October, 1978

Treatment	Mounting number DMRT	Cocooning number DMRT	Sound pupa number DMRT	Whole cocoon weight (g) DMRT	Cocoon shell weight (cg) DMRT	Cocoon shell ratio (%) DMRT
1. Duration in dipping, 10 min.	196 a	188 a	151 a	1.94 a	37.5 a	19.3 a
2. Durtaion in dipping, 15 min.	193 a	189 a	157 a	1.96 a	37.9 a	19.4 a
3. Duration in dipping, 20 min.	198 a	192 a	163 a	1.92 a	37.8 a	19.6 a
4. Duration in dipping, 25 min.	197 a	193 a	152 a	1.93 a	37.7 a	19.5 a
5. Durtaion in dipping, 30 min.	194 a	190 a	150 a	1.96 a	38.0 a	19.4 a
CV %	1.5	1.7	13.1	2.4	1.8	2.4

16. Effect of Juvenile Hormone (Manta) on the Growth of Silkworm

Sompoti AKAPANTHU

Yokichi KOBARI and Hiromu AKAI (1) found that administration of the standard Manta solution (diluted 5 – 500 times) during the 48th to 60th hour of the 5th instar, resulted in the increase of the cocoon shell weight by 6 to 10 percent, using C131 x N136, a Japanese silkworm variety. We tried to test this effect in our laboratory where climatic facotrs and silkworm variety are different from Japan.

This report has been arranged to include the results done after a preliminary note, reported in the previous meeting on March, 1979 (3).

MATERIAL AND METHOD

1. Time of test and silkworm race tested: January – October, 1979 and K1 x K14

2. Feeding

6:00 o'clock	30% of daily supplied leaves
11:00 o'clock	30% of daily supplied leaves
16:00 o'clock	40% of daily supplied leaves

3. Lot tested: Randomized complete "blocks" with 5 treatments and 4 replications

   1) Control: Not treated
   2) Juvenile hormone, sprayed immediately after the 4th ecdysis
   3) Juvenile hormone, sprayed at the 24th hour of the 5th instar
   4) Juvenile hormone, sprayed at the 48th hour of the 5th instar
   5) Juvenile hormone, sprayed at the 72th hour of the 5th instar

   Juvenile hormone dose: 50 times, 150 c.c./200 larvae

   * Component of juvenile hormone: Methoprene.

RESULT

The results are shown in Tables 1, 2, 3, 4, 5, 6, 7 and 8.

Unexpectedly, the activities of juvenile hormone sprayed showed hardly clear effects on quality of cocoons among treatments under these rearing conditions.

LITERATURE

(1) KOBARI, Y. and H. AKAI: Utilization of the Manta (Synthetic Compound with Juvenile Hormone Activity) for the Silkworm Rearing. Jour. Seri. Japan 49 (4), 1978.
(2) KING, R.C.: Handbook of Genetics Vol. 3, 1976, New York.
(3) AKAPANTHU, S.: Effect of juvenile hormone (Manta) on the growth of silkworm at the 5th stage (a preliminary note) Bul. Thai Seri. Res. and Train. Centre, No. 9, 1979.

Table 1. Analysis of varience, Jan. – Feb., 1979

SV	df	Mounting number MS	F	Sound pupa number MS	F	Sound cocoon weight (g) MS	F	Cocoon weight (g) MS	F	Cocoon shell weight (cg) MS	F	Cocoon shell percent (%) MS	F
Rep.	3	176.5833		154.4500		1048 3333		0.0074		2.4500		0.3660	
Treatment	4	45.1250	1	44.1750	1	34.3750	1	0.0011	1.83 ns	1.0750	4.45*	0.6708	3.99*
Error	12	114.4583		145.5750		332.7083		0.0006		0.2417		0.1681	
CV %		5.6		6 5		6.5		1.6		1.6		2.0	

Table 2. Means, Jan. – Feb. 1979 (HAKITATE: Jan. 15)

Treatment	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. Control	189 a	185 a	280 a	1.54 a	31.8 ab	20.6 a
2. 0 hour	193 a	191 a	285 a	1.57 a	21.0 a	20.4 a
3. 24 hour	185 a	182 a	279 a	1.58 a	32.2 a	20.4 a
4. 48 hour	192 a	188 a	284 a	1.58 a	31.2 b	19.7 b
5. 72 hour	192 a	188 a	285 a	1.58 a	31.0 b	19.7 b

Table 3. Analysis of varience, June – July, 1979

SV	df	Mounting number	Sound pupa number	Whole cocoon weight (g)	Cocoon shell weight (g)
Replication	3	78 9333	97 5166	607.9166	0.0054
Treatment	4	791.5500**	1224.4250	8682.5000**	0.0026 ns
Error	12	61.3500	152.8916	389.1666	0.0011
CV %		4.1	6.7	7.9	2.4

Table 4. Means, June – July, 1979 (HAKITATE: June, 1979)

Treatment	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)
1. Control	198 a	197 a	274 a	1.42 a
2. 0 hour	198 a	196 a	270 a	1.39 a
3 24 hour	196 a	192 a	272 a	1.44 a
4. 48 hour	190 a	178 a	255 a	1.44 a
5. 72 hour	155 b	155 b	165 b	1.39 a

Table 5. Analysis of varience, Aug. – Sept. 1979

SV	df	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	57.5617	175.0667	842.5833	0.0031	2.1833	0.0913
Treatment	4	195.9255**	1154.9250**	4857.5000**	0.0053 ns	11.9250**	2.8142**
Error	12	41.5583	56.8583	268.3333	0.0022	1.0583	0.3059
CV %		3.3	4.0	6.0	2.9	3.3	. 2.8

Table 6. Means, Aug. – Sept. 1979 (HAKITATE. Aug. 1979)

Treatment	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. Control	200 a	200 a	300 a	1.59 ab	32.75 a	20.50 a
2. 0 hour	199 a	192 ab	280 ab	1.60 ab	32.25 a	20.10 a
3. 24 hour	196 a	186 b	268 b	1.62 a	31.25 ab	19.22 b
4. 48 hour	198 a	196 ab	290 ab	1.61 a	30.00 bc	18.67 b
5. 72 hour	183 a	157 c	211 c	1.53 b	28.50 c	18.65 b

Table 7. Analysis of varience, Oct. – Nov. 1979

SV	df	Mounting number	Sound pupa number	Sound cocoon weight (g)	Cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Replication	3	18.1833	43.1167	700.5333	0 0100	5.200	0.2700
Treatment	4	7.7000 <1	9.0750	1291.7000	0.0075	2.3750	0.3170
			1.35 ns	3.62*	1.55 ns	1.14 ns	1.38 ns
Error	12						
CV %		1.5	1.3	5.7	4.0	4.5	2.5

Table 8. Means, Oct. - Nov 1979 (HAKITATL Oct. 1979)

Treatment	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. Control	198 a	197 a	330 a	1.71 a	32.50 a	19.00 a
2. 0 hour	197 a	196 a	335 a	1.70 a	32.00 a	18.77 a
3. 24 hour	199 a	198 a	342 a	1.74 a	32.00 a	18.32 a
4. 48 hour	198 a	196 a	338 a	1.72 a	32 75 a	19.02 a
5 72 hour	195 a	194 a	298 a	1.63 a	30 75 a	18.82 a

17. Study on Appropriate Time of Bed Cleaning at the 5th Stage of Silkworm Larvae

Sompoti AKAPANTHU

It is very important that silkworms must be protected from the rearing bed to be dirty with disinfectants, remaining leaves, their faeces, silk or dead silkworms etc. The experiment was started to know an appropriate time of bed-cleaning at the 5th stage of silkworms.

MATERIAL AND METHOD

1. Time of test : August and October, 1979

2. Race : K1xK8

3. Lot tested : RCB with 5 treatments and 4 replications

   1) Bed cleaning, once a day
   2) Bed cleaning, once in two days
   3) Bed cleaning, once in three days
   4) Bed cleaning, once in four days
   5) Bed cleaning, once in five days

4. Feeding

   6:00 o'clock, 30% of daily supplied leaves
   11:00 o'clock, 30% of daily supplied leaves
   16:00 o'clock, 40% of daily supplied leaves

5. Number of silkworm

   1) Young stage: newly hatched silkworms, 1g/rep.
   2) Old stage: 1,000 larvae (200 larvae x 5 rep./treatment)

RESULT

The results are shown in Tables 1, 2, 3 and 4.

No significant results among treatments were recognized. The omission of bed-cleaning in the 5th stage may have no serious effect on the physiology of silkworms.

Table 1. Analysis of variance, August, 1979

SV	df	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Rep.	3	19.1167	24.9833	68,3333	0.0025	0.1333	0.1793
Treatment	4	18.0000	30.3250 ns	198.1250 ns	0.0020 ns	0.1750 ns	0.2682 ns
Error	12	14.8667	19.3583	138.1250	0.0011	0.5083	0.2072
CV %		1.9	2.2	4.0	2.0	2.1	2.3

Table 2. Table of means, August, 1979

Treatment	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. Every day	197 a	195 a	280 a	1.63 b	32.75 a	20.00 a
2. Every 2 says	199 a	198 a	290 a	1.65 ab	32.50 a	19.70 a
3. Every 3 days	199 a	198 a	296 a	1.64 ab	33.00 a	20.12 a
4 Every 4 days	196 a	194 a	298 a	1.69 a	33.00 a	19.55 a
5. Every 5 days	194 a	192 a	294 a	1.67 ab	32.75 a	19.57 a

Table 3. Analysis of variance, October, 1979

SV	df	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon welgit (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Rep.	3	30.5333	354.5833	731.2500	0.0014	0.4500	0.0440
Treatment	4	13.0750 1.81 ns	124.8750 1.57 ns	279.3750 2.02 ns	0.0007 1	0.4250 1	0.1082 1
Error	12	7.2417	79.7083	138.5417	0.0027	0.9917	0.5302
CV %		1.3	4.7	4.3	3.4	3.2	3.5

Table 4. Table of means, October, 1979

Treatment	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole weight weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. Every day	197 a	192 a	279 a	1.50 a	30.75 a	20.40 a
2. Every 2 days	198 a	194 a	272 a	1.50 a	30.75 a	20.45 a
3. Every 3 days	196 a	191 a	272 a	1.52 a	30.75 a	20.22 a
4. Every 4 days	198 a	198 a	269 a	1.48 a	30.00 a	20.17 a
5. Every 5 day	194 a	180 a	256 a	1.52 a	30 50 a	20.05 a

18. Surveys on Personal Differences in the Silkworm Rearing

Wanchai SUKCHAROEN, Theera NGARMPRASIT,
Pornthip PETCHMONT and Sompoti AKAPANTHU

Cocoon crops are dependable upon many factors; such as silkworm variety, mulberry leaves, rearing method, worker's techniques, etc. The surveys were tried to know the differences among worker's techniques in the sericultural practices.

MATERIAL AND METHOD

1. Time of test : June – July, 1979

2. Lot of test : RCB with 4 treatments (persons) and 6 replications

3. Silkworm variety : K1xK14

4. Number of silkworms

   1) Young stage: newly hatched worms 0.5 g/treatment
   2) Old stage: 1.200 (200 larvae x 6 replications)/treatment

RESULT

It may be concluded, as shown in Table 1, that the difference among persons could be recognized, showing better results of the quality and quantity of cocoons in the case of C.

Table 1. Table of means, July, 1979

Treatment	Mounting number	Sound cocoon-ing number	Total cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
A	197 a	195 a	276 b	1.46 b	28.67 b	19.57 b
B	188 b	183 ab	257 c	1.41 c	27.67 bc	19.73 ab
C	196 a	180 b	298 a	1.71 a	34.50 a	20.12 a
D	197 a	195 a	270 bc	1.42 c	27.17 c	19.13 b

19. F_1 Hybrid Test of Silkworm

Sompoti AKAPANTHU

In this test three silkworm varieties (F_1 hybrids) sent from Japan were reared in contrast to the current ones in our Centre.

MATERIALS AND METHOD

1. Time of test and silkworm race used:

    1) August – September 1979

    2) Race: N115xC108, N122xC115 and N112xC110 sent from Japan and K1xK14, K1xK18, and K1xK8 in our Centre

2. Number of silkworms

    1) Young stage: 3 batches/treatment (race)

    2) Old stage: 600 larvae (200x3 rep.)/treatment (race)

    3) Feeding

    6.00 o'clock: 30% of daily supplied leaves
    11.00 o'clock: 30% of daily supplied leaves
    16.00 o'clock: 40% of daily supplied leaves

RESULT

Among the F_1 hybrids tested, N115xC108 and N122xC115 got better results, showing highly significant differences in cocoon weight and cocoon shell weight (with a single exception of K1xK18) to the others, as shown in Tables 1 and 2.

Note: Three hybrids, N115xC108, N122xC115, and N112xC110 were sent from Japan by the courtesy of the Government in August, 1979.

Table 1. Analysis of variance, August, 1979

SV	df	Mounting number	Sound cocoon number	Total cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Treatment	5	14.6333 ns	173.3888*	3503 3333**	0.0303**	15.9555**	1.7556*
Error	12	6.7778	40.5555	311.1111	0.0040	0.9444	0.4989
CV %		1.3	3.3	5.9	3.9	3.0	3.5

Table 2. Table of means, August, 1979

Treatment	Mounting number	Sound cocoon number	Total cocoon weight (g)	Whole cocoon weight (cg)	Cocoon shell weight (cg)	Cocoon shell percent (%)
N115xC108	198 a	198 a	335 a	1.70 ab	34.33 a	20.20 a
N122xC115	200 a	199 a	343 a	1.78 a	35.00 a	19.56 ab
N112xC110	200 a	199 a	298 b	1.63 b	30.33 bc	18.66 b
K1xK14	195 a	185 bc	262 c	1.49 c	30.00 c	20.10 a
K1xK18	195 a	182 c	283 c	1.67 ab	35.00 a	20.93 a
K1xK8	198 a	194 ab	268 bc	1.58 bc	32.00 b	20.23 a

20. F_2 Hybrid Test of Silkworm

Sompoti AKAPANTHU

The author tried to compare F_2 Hybrids derived from F_1 hybrids sent from Japan with F_2 hybrids in our Centre.

MATERIALS AND METHOD

1. Time of test and silkworm race used

   1) October – November 1979

   2) Race: $(N115xC108)_2$, $(N122xC115)_2$, $(N112xC110)_2$, $(K1xK14)_2$, $(K1xK18)_2$, and $(K1xK8)_2$

2. Number of silkworm

   1) Young stage: 3 batches/treatment (race).

   2) Old stage: 600 larvae (200x3 rep.)/treatment (race)

   3) Feeding

   6.00 o'clock: 30% of daily supplied leaves
   11.00 o'clock: 30% of daily supplied leaves
   16.00 o'clock: 40% of daily supplied leaves

RESULT

Mounting number, sound cocoon number, and cocoon weight showed highly significant, among F_2 hybrids tested, though cocoon shell weight and cocoon shell percent remained significant (Table 1). And, $(K1xK18)_2$ variety was most superior in the items surveyed, followed by $(K1xK14)_2$, showing high fitness to the climatic conditions in our country.

Note: Three hybrids, N115xC108, N122xC115, and N112xC110 were sent from Japan by the country of the Government in August, 1979.

Table 1. Analysis of varience, October 1979

SV	df	Mounting number	Sound cocoon number	Total cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Treatment	5	600.5888**	1156.4555	1384.7222	0.0021	3.555	2.4392
			20.21**	6.43**	1.23 ns	3.56	11.14*
Error	12	43.1666	57.2222	215.2777	0.0017	1.0000	0.2188
CV %		3.7	4.4	6.9	3.2	4.5	2.77

Table 2. Table of means, October, 1979

Treatment	Mounting number	Sound cocoon number	Total cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
$(N115xC108)_2$	177 b	170 b	197 b	1.30 a	21.23 bc	16.40 cd
$(N122xC115)_2$	152 c	134 c	182 b	1.29 a	22.00 ab	17.03 bc
$(N112xC110)_2$	181 ab	175 ab	207 ab	1.29 a	20.67 c	16.00 d
$(K1xK14)_2$	184 ab	181 ab	227 ab	1.28 a	23.00 ab	18.03 a
$(K1xK18)_2$	191 a	187 a	232 a	1.31 a	23.67 a	18.13 a
$(K1xK8)_2$	189 ab	186 a	235 a	1.23 b	22.00 ab	17.83 ab

21. Qualities of Cocoons Mounted in Same Different Types of Cocooning Frames, Wire, Plastic, Kok Grass and Rotary (2)

Wollapa NGARMPRASIT and Wichien KWUN-ON

The rotary cocooning frame to be recommended to attain better cocoons have been imported from foreign countries and are very high in price. The Thai Sericultural Research and Training Center has worked in close cooperation with Public Welfare Department, Agriculture Extension Department, and Accelerated Rural Development in the silkworm rearing to be further developed in this country.

This experiment was carried out to affirm the practical values of some kinds of cocooning frames of domestic material, compared with rotary and plastic frames (1).

MATERIAL AND METHOD

1. Material

   1) Silkworm variety: K14xK1
   2) Cocooning frame: Wire, Kok grass, plastic and rotary frames.

2. Method: Ramdomized Complete Blocks composed of 5 replications and 4 treatments (cocooning frames).

   1) 2 wire frames for matured larvae, 375 heads per each.
   2) 3 plastic frames for matured larvae, 250 heads per each.
   3) 3 Kok grass frames for matured larvae, 250 heads per each.
   4) 1 rotary frame for matured larvae, 750 heads.

3. Rearing method.

   1) Feeding time for young silkworms: 6:00, 10:00, 13:30, and 16:00 o'clock.

   2) Feeding time for old silkworms: 6:00, 11:00, and 16:00 o'clock.

   3) Number of silkworms:

      Young silkworms, 10,000 heads
      Old silkworms by shoot rearing – 4,000 heads

4. Items of survey

   1) Frame number
   2) Good cocoon number
   3) Bad cocoon number
   4) Silkworms mounted
   5) Whole cocoon weight
   6) Cocoon shell weight
   7) Cocoon shell parcentage

RESULT AND CONSIDERATION

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

The efficiencies of wire and Kok grass frame, compared to rotary frame, were slightly inferior in the data of good cocoon number, bad cocoon number, good cocoon weight and bad cocoon weight.

From the results it may be said the domestic frames will be able to replace the imported rotary and plastic frame, if necessary.

LITERATURE

(1) NGARMPRASIT, W. and W. KWUN-ON: Qualities of cocoons mounted in some different types of cocooning frames, wire, plastic, Kok grass and rotary. Bul, Thai Seri. Res. and Train. Center No. 8. 1979.

Table 1-1 Analysis of variance, (HAKITATE: June 15, 1978)

SV	df	Means squares (F)			
		Good cocoon no.	Bad cocoon no.	Good cocoon wt. (g)	Bad cocoon wt. (g)
Replication	4	2,377.25 (2.99) ns	1,967.62 (6.98)**	1,298.88 (<1)	1,769.75 (3.64)*
Treatment	3	2,916.80 (3.67)*	518.73 (1.84) ns	5,340.05 (1.93) ns	654.45 (1.35) ns
Error	12	794.72	281.86	2,763.51	486.12
CV %		4.2	36.8	6.4	39.1

Table 1-2. Table of means

Treatment	Good cocoon no.	DMRT	Bad cocoon no.	DMRT	Good cocoon wt (g)	DMRT	Bad cocoon wt (g)	DMRT
Plastic frame	689	a	41	a	840	a	54	a
Kok grass frame	649	ab	52	a	819	a	72	a
Wire frame	632	b	55	a	773	a	53	a
Rotary frame	662	ab	34	a	845	a	45	a

Table 1-3. ANOVS

SV	df	Mean squares (F)		
		Whole cocoon wt. (g)	Cocoon shell wt. (cg)	Cocoon shell percent (%)
Replication	4	0.0047	0.0250	1.4860
Treatment (A)	3	0.0016 (<1)	3.0250 (1.70) ns	2.0063 (1.20) ns
Error (a)	12	0.0021	1.7750	1.6672
Silkworm sex (B)	1	0.4141 (188.55)**	0.0250 (<1)	102.4000 (191.98)**
AxB	3	0.0029 (1.31) ns	1.8917 (1.52) ns	0.7920 (1.48) ns
Error (b)	16	0.0022	1.2375	0.5334
CV (a)%		3.6	5.4	6.6
CV (b)%		3.7	4.5	3.7

Table 1-4. Table of means

Treatment	Whole cocoon wt. (g)	Cocoon whell wt. (cg)	Cocoon shell percent (%)
Plastic frame	1.24 a	23.8 a	19.4 a
Kok grass frame	1.26 a	23.9 a	19.0 a
Wire frame	1.26 a	24.4 a	19.5 a
Rotary frame	1.26 a	25.0 a	20.1 a
Siklworm sex			
♂	1.15 b	24.3 a	21.1 a
♀	1.36 a	24.2 a	17.9 b

Table 2-1. Analysis of variance (HAKITATE: August 15, 1978)

SV	df	Means squares (F)			
		Good cocoon no.	Bad cocoon no.	Good cocoon wt. (g)	Bad cocoon wt. (g)
Replication	4	757.92 (1.22) ns	615.38 (1.19) ns	117.05 (<1)	3,909.12 (3.25) ns
Treatment	3	15,788.33 (25.32)**	11,640.18 (22.49)**	17,531.40 (7.59)**	24,022.67 (20.00)**
Error	12	623.62	517.64	2,308.82	1,201.29
CV %		3.8	26.3	4.3	25.4

Table 2-2. Table of means

Treatment	Good cocoon no.	DMRT	Bad cocoon no.	DMRT	Good cocoon wt. (g)	DMRT	Bad cocoon wt. (g)	DMRT
Plastic frame	663	b	69	b	1,081	b	115	b
Kok grass frame	628	c	96	b	1,074	b	163	c
Wire frame	583	d	147	c	1,058	b	214	d
Rotary frame	716	a	32	a	1,188	a	52	a

Table 2-3. Analysis of variance

SV	df	Mean squares (F)		
		Whole cocoon wt. (g)	Cocoon shell wt. (cg)	Cocoon shell percent (%)
Replication	4	0.0097	3.1875	0.3296
Treatment (A)	3	0.0384 (9.86)**	26.0917 (6.15)**	0.5122 (<1)
Error (a)	12	0.0039	4.2375	0.5400
Silkworm sex (B)	1	1.5801 (1133.67)**	164.0250 (149.11)**	52.2122 (137.35)**
AxB	3	0.0022 (1.59) ns	2.2917 (2.08) ns	1.2302 (3.23) ns
Error (b)	16	0.0014	1.1000	0.3801
CV (a)%		3.5	5.8	3.6
CV (b)5		2.1	2.9	3.0

Table 2-4. Table of means

Treatment	Whole cocoon wt. (g)	Cocoon shell wt. (cg)	Cocoon shell percent (%)
Plastic frame	1.69 b	33.6 b	20.0 a
Kok grass frame	1.73 b	34.6 b	20.2 a
Wire frame	1.83 a	37.4 a	20.5 a
Rotary frame	1.72 b	34.9 b	20.4 a
Silkworm sex			
♂	1.55 b	33.1 b	21.4 a
♀	1.94 a	37.2 a	19.1 b

Table 3-1. Analysis of variance (HAKITATE: October 15, 1978)

SV	df	Means squares (F)			
		Good cocoon no.	Bad cocoon no.	Good cocoon wt. (g)	Bad cocoon wt. (g)
Replication	4	5,041.32 (1.90) ns	2,063. 70 (3.84)*	10,359.68 (<1)	12.238.62 (7.34)**
Treatment	3	16.625.78 (6.28)**	9,303.25 (17.32)**	69,716.85 (4.57)*	22,788.18 (13.67)**
Error	12	2,648.49	537.17	15,258.81	1,667.39
CV %		8.7	19.5	11.6	18.0

Table 3-2. Table of means

Treatment	Good cocoon no.	DMRT	Bad cocoon no.	DMRT	Good cocoon wt. (g)	DMRT	Bad cocoon wt. (g)	DMRT
Plastic frame	599	a	107	b	1,020	b	202	ab
Kok grass frame	607	a	122	b	1,027	b	247	b
Wire frame	504	b	175	c	959	b	307	c
Rotary frame	638	a	71	a	1,230	a	148	a

Table 3-3. Analysis of variance

SV	df	Means square (F)		
		Whole cocoon wt. (g)	Cocoon shell wt. (cg)	Cocoon shell percent (%)
Replication	4	0.0062	1.8125	1.0244
Treatment (A)	3	0.0547 (8.09)**	37.2917 (11.25)**	1.0182 (2.14) ns
Error (a)	12	0.0068	3.3125	0.4747
Silkworm sex (B)	1	2.2090 (212.91)**	133.2250 (34.71)**	77.5622 (31.33)**
AxB	3	0.0117 (1.12) ns	1.6250 (<1)	0.6676 (<1)
Error (b)	16	0.0104	3.8375	2.4756
CV (a)%		4.3	5.0	3.5
CV (b)%		5.3	5.4	8.1

Table 3-4. Table of means

Treatment	Whole cocon wt. (g)	Cocoon shell wt. (cg)	Cocoon shell percent (%)
Plastic frame	1.83 c	34.4 b	19.0 a
Kok grass frame	1.85 bc	34.6 b	18.9 a
Wire frame	1.99 a	38.3 a	19.5 a
Rotary frame	19.3 ab	37.2 a	19.5 a
Silkworm sex			
♂	1.66 b	34.3 b	20.6 a
♀	2.14 a	38.0 a	17.8 b

Table 4-1. Analysis of variance (HAKITATE: January 15, 1979)

SV	df	Mean squares (F)			
		Good cocoon no.	Bad cocoon no.	Good cocoon wt. (g)	Bad cocoon wt. (g)
Replication	4	191.58 (<1)	155,20 (<1)	2,863.08 (<1)	923.58 (<1)
Treatment	3	829.25 (1.41) ns	1,320.18 (2.23) ns	13,711.65 (2.79) ns	6,181.78 (3.80)*
Error	12	589.38	590.93	4,911.78	1,627.08
CV %		3.5	51.0	6.3	47.8

Table 4-2. Table of means

Treatment	Good cocoon no.	DMRT	Bad cocoon no.	DMRT	Good cocoon wt. (g)	DMRT	Bad cocoon wt. (g)	DMRT
Plastic frame	692	a	32	a	1,069	ab	48	a
Kok grass frame	680	a	59	a	1,132	ab	115	b
Wire frame	669	a	64	a	1,049	b	114	b
Rotary frame	698	a	36	a	1,160	a	60	ab

Table 4-3. Analysis of variance

SV	df	Means square (F)		
		Whole cocoon wt. (g)	Cocoon shell wt. (cg)	Cocoon shell percent (%)
Replication	4	0.0017	1.9000	0.7566
Treatment (A)	3	0.0201 (4.01)*	18.9583 (12.63)**	1.5516 (3.56)*
Error (a)	12	0.0050	1.5000	0.4351
Silkworm sex (B)	1	1.2602 (1170.96)**	0.0250 (<1)	202.0502 (192.33)**
AxB	3	0.0012 (1.09) ns	0.6917 (<1)	0.3456 (<1)
Error (b)	16	0.0011	2.4000	1.0505
CV (a)%		4.5	4.0	3.3
CV (b)%		2.1	5.1	5.2

Table 4-4. Table of means

Treatment	Whole cocoon wt. (g)	Cocoon shell wt. (cg)	Cocoon shell percent (%)
Plastic frame	1.50 b	28.6 b	19.3 b
Kok grass frame	1.58 a	31.6 a	20.2 a
Wire frame	1.54 ab	29.6 b	19.5 b
Rotary frame	1.60 a	31.1 a	19.7 ab
Silkworm sex			
♂	1.38 b	30.2 a	21.9 a
♀	1.73 a	30.2 a	17.4 b

22. Training on Silkworm Rearing in Last One Year

Wollapa NGARMPRASIT and Wichien KWUN-ON

In last year (May, 1979 – Feb., 1980) we had three trainings on silkworm rearing as shown in Table 1.

Every training consisted of lectures and practices. The experienced officials of each section lectured on methods of mulberry cultivation, silkworm rearing, silkworm egg production, breeding of silkworm races, control of diseases and insect pests of mulberry and silkworm, and silk reeling.

The practices were concentrated on the techniques of cooperative rearing of young silkworms and shoot rearing of grown silkworms.

Table 1. Training on silkworm rearing in last year

Order	Term	Occupation	Trainee		Total
			Man	Woman	
Short term training	1979 May 1 – May 10	Public Welfare Dep. Officer	21	2	23
		Total	21	2	23
35th	1979 June 7– July 8	Extention Officer	44	6	50
		Teacher	1	–	1
		Total	45	6	51
36th	1980 Jan. 15 – Feb. 15	Extension Officer	49	6	55
		Sericultural Officer	2	–	2
		Total	51	6	57
		Grand Total	117	14	131

23. Study on the Practical Characters of Japanese Bivoltine Silkworm Strains, K1, K6, and K13

Paiwan LEKUTHAI, Sutathip BUTRACHUND and Sompong KRAJPOT

To raise the productivity of Thai silk, we are carrying out breeding of bivoltine races instead of Thai polyvoltine ones which cannot spin good cocoons. At first we tested the practical characters of many pure bivoltine races imported from Japan and obtained the results that some of them were suitable for rearing in Thailand (1), (2). Continued improvement has produced highly efficient Japanese bivoltine silkworm races, K1 and K6, using the silkworm varieties sent from Japan. These bivoltine races have been improved continuously from the view point of their viability and silk productivity in our Centre. Using these pure bivoltine races, we succeeded in the breeding of a new strain, K13, a pure Japanese bivoltine race that should be extend in the near future.

MATERIAL AND METHOD

Our breeding started by "cross breeding", using the hybrids, N124 x C124 and (KINSHU x SHOWA)F_2 x K1, both Japanese bivoltine races sent from Japan. In the breeding process, individual selection had been continued during 1st–5th generations, and after that batch selection was repeated to rear better batches in the next season. K1 started in 1970 from pea-nut shape cocoon of N124 x C124. K6 started in 1973 from pea-nut shape cocoon of (KINSHU x SHOWA)F_2 x K1. K13, another Japanese bivoltine race, started from F_1 hybrid of K6 (female) and K1 (male) in 1974(3). The items put stress in the batch selection were as follows:

1. Uniformity in growth.
2. Stoutness, indicated by cocooning ratio and sound pupa ratio.
3. Silk productivity, high in cocoon shell weight and ratio.
4. Egg laying ability.

RESULT AND CONCLUSION

Results are shown in Tables 1 – 4.

K1 (the oldest among 3 races, K1, K6, and K13) is the highest in viability and high in productivity, although cocoon shell ratio is not so high as K6 and K13. It is easy to rear and takes a short time in rearing. From the early selection up to now, we could conclude that K1 is available and good enough as the parent of hybrid which will be distributed to farmers.

K6 is not so strong as the other races, but high in cocoon shell weight and cocoon shell ratio, having an excellent cross ability. K6 takes a longer time to rear than K1 and K13.

K13 is the highest in productivity and high in viability. It is easy to rear and takes the same short time as K1 in rearing. And, it is expected that K13 may be promising as a parent race of new practical combinations to be distributed to farmers.

Further, the batch selection is to be continued to find out better lineage with good quality of cocoon in the next year.

LITERATURE

(1) LEKUTHAI, P., J. JAROONCHAI and S. BUTRACHUND: Survey on the practical characters of new strains of bivoltine silkworm, K1, K6 and K7. Bul. Thai Seri. Res. and Train. Centre, No. 5, 1975.

(2) LEKUTHAI, P., S. BUTRACHUND and S. KRAIPOT: Survey on the current parent silkwarm races, T, K1, K6 and K14. Ibid., No. 7, 1977.

(3) LEKUTHAI, P., S. BUTRACHUND and S. KRAIPOT: Survey on the practical characters of a new strain of Japanese bivoltine silkworm, K13 (A8). Ibid., No. 9, 1979.

Table 1. Temperature and humidity in rearing room during rearing period.

Rearing season	Temperature (°C)			Humidity (%)
	maximum	minimum	average	
Jan. 1979	34.0	18.0	25.1	70
June 1979	36.5	23.0	28.4	80
Aug. 1979	38.0	21.5	29.2	75
Oct. 1979	35.0	21.5	27.0	74

Table 2. Practical characters on selection of K1

Generation	No.	Lineage	Term 1-5 stage d.h.	Cocoon-ing ratio %	Sound pupa ratio %	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell ratio %	No. of eggs laid
	11	11 x 14	23.23	95.4	92.9	1.05	19.8	18.9	
	12	11 x 14	23.23	97.1	93.1	1.01	18.6	18.4	
	13	11 x 14	23.23	96.0	90.9	1.06	20.0	18.9	
	14	11 x 14	23.23	92.9	89.1	1.02	18.8	18.4	
	15	11 x 14	23.23	95.1	87.7	1.07	20.4	19.1	
	16	23 x 29	23.23	94.9	91.1	0.96	17.8	18.5	
32nd	17	23 x 29	23.23	94.9	91.7	0.97	17.6	18.1	
(Jan. '79)	18	23 x 29	23.23	95.7	92.0	1.04	19.8	19.0	
	19	23 x 29	23.23	98.9	96.9	0.97	17.6	18.1	
	20	23 x 29	23.23	96.3	91.7	1.04	19.8	19.0	
	21	23 x 29	23.23	97.7	92.0	1.05	20.0	19.1	
	22	28 x 12	23.23	98.3	96.0	1.00	18.6	18.6	
	23	28 x 12	23.23	94.6	91.4	1.04	18.6	17.9	
	24	28 x 12	23.23	97.4	95.1	1.03	19.0	18.5	
	25	28 x 12	23.23	97.1	95.1	1.03	18.8	18.3	
Average			23.23	96.2	92.5	1.02	19.0	18.6	449
	11	21 x 18	22.23	94.2	84.3	1.01	17.8	17.6	
	12	21 x 18	22.23	97.2	87.1	1.02	18.2	17.8	
	13	21 x 18	22.23	93.5	88.6	0.92	15.6	17.0	
	14	21 x 18	22.23	96 6	95.1	1.04	18 6	17.9	
	15	21 x 18	22.23	95.7	91.7	0.97	17.2	17.7	
	16	11 x 20	22.23	96.3	93.9	1.05	18.4	17.5	
33rd	17	11 x 20	21.23	94.8	93.9	0.91	15.4	16.9	
(June '79)	18	11 x 20	22.23	96.0	93.9	1.08	19.2	17.8	
	19	11 x 20	22.23	98.5	96.3	1.06	18.8	17.7	
	20	11 x 20	22.23	97.9	93.9	1.01	18.2	18.0	
	21	15	22.23	95.7	92.0	1.05	18.6	17.7	
	22	15	22.23	96.3	93.9	1.04	18.6	17.9	
	23	15 x 21	22.23	93.9	92.3	1.04	18.4	17.7	
	24	15 x 21	22.03	97.5	95.1	1.02	17.6	17.3	
	25	13 x 18	22.23	94.8	84.9	0.99	17.6	17.8	
Average			22.20	95.9	91.8	1.01	17.9	17.6	389
	11	18 x 14	20.23	96.4	91.2	1.12	18.8	16.8	
	12	18 x 14	21.05	96.4	91.8	1.18	20.4	17.3	
	13	18 x 14	20.23	95.8	91.8	1.05	17.6	16.8	
	14	18 x 14	21.05	96.1	91.2	1.11	19.0	17.1	
34th	15	14 x 18	21.05	97.3	95.2	1.17	20.2	17.3	
(Aug. '79)	16	18	21.05	94.5	86.1	1.15	20.0	17.4	
	17	22 x 19	21.05	96.4	93.0	1.11	18.8	16.9	
	18	22 x 19	21.05	96.1	93.6	1.14	19.8	17.4	
	19	21 x 16	21.05	95.8	91.2	1.10	18.4	16.7	
	20	21 x 16	21.05	95.2	91.8	1.07	18.2	17.0	
Average			21.04	96.0	91.7	1.12	19.1	17.1	354
	11	15 x 18	22.23	99.7	97.5	1.06	19.4	18.3	
	12	15 x 18	22.23	98.5	95.8	1.09	20.0	18.3	
	13	15 x 18	22.21	99.1	95.5	0.92	15.8	17.2	
	14	15 x 18	22.23	98.2	95.5	1.10	20.0	18.2	
35th	15	15 x 18	23.05	96.7	91.2	1.13	20.4	18.1	
(Oct. '79)	16	18 x 15	22.23	97.9	96.0	1.11	20.2	18.2	
	17	12 x 15	23.05	96.4	93.6	1.06	18.8	17.7	
	18	12 x 15	22.23	97.0	94.8	0.96	16.4	17.1	
	19	12 x 15	22.23	96.4	93.0	1.08	19.6	18.1	
	20	12 x 15	22.23	98.5	96.6	1.08	19.2	17.8	
Average			23.00	97.8	95.0	1.06	19.0	17 9	353

Note: Underlined figures are the parents of the next generation.

Table 3. Practical characters on selection of K6

Generation	No.	Lineage	Term 1-5 stage d.h.	Cocoon-ing ratio %	Sound pupa ratio %	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell ratio %	No. of eggs laid
	26	37 x 33	25.21	97.6	96.8	1.01	19.4	19.2	
	27	37 x 33	25.21	96.2	93.5	1.02	20.4	20.0	
	28	37 x 33	25.21	96.6	96.8	0.97	17.4	17.9	
	29	37 x 33	25.21	98.8	96.8	1.06	21.4	20.2	
25th	30	37 x 33	25.21	97.9	97.1	0.95	17.0	17.9	
(Jan. '79)	31	35 x 31	25.21	98.5	97.1	0.97	18.0	18.6	
	32	35 x 31	25.21	97.9	94.7	1.04	19.6	18.8	
	33	35 x 31	25.21	99.0	97.9	0.99	19.2	19.4	
	34	35 x 31	25.21	96.5	95.0	1.01	19.6	19.4	
	35	34 x 36	25.21	96.2	92.4	1.08	22.2	20.6	
Average			25.21	97.6	95.8	1.01	19.4	19.2	357
	26	35 x 29	24.23	91.7	87.1	1.02	20.8	20.4	
	27	35 x 29	24.05	92.0	86.0	0.95	17.0	17.9	
	28	35 x 29	24.23	96.3	92.9	1.00	20.0	20.0	
26th	29	35 x 29	24.21	91.4	87.1	1.01	20.4	20.2	
(June '79)	30	35 x 29	24.21	95.4	92.6	0.99	19.4	19.6	
	31	27 x 34	24.21	94.6	91.4	0.95	18.4	19.4	
	32	27 x 34	24.05	96.0	91.4	0.88	15.6	17.7	
	33	27 x 34	24.21	94.0	90.0	0.91	17.2	18.9	
Average			24.18	93.9	89.8	0.96	18.6	19.3	323
	21	28 x 30	22.23	84.0	76.0	1.11	24.4	22.0	
	22	28 x 30	22.23	82.3	73.7	1.11	24.0	21.6	
	23	28 x 30	23.05	84.3	77.7	1.14	24.8	21.8	
27th	24	28 x 30	23.21	86.3	81.1	1.18	26.0	22.0	
(Aug. '79)	25	26 x 29	23.21	86.3	79.4	1.18	25.2	21.4	
	26	26 x 31	23.21	88.0	78.3	1.15	25.4	22.1	
	27	26 x 31	23.21	85.4	79.7	1.15	25.2	21.9	
	28	26 x 31	23.05	89.7	84.3	1.13	24.0	21.2	
Average			23.21	85.8	78.8	1.14	24.9	21.8	341
	21	24 x 27	23.23	95.4	91.0	1.14	23.6	20.7	
	22	24 x 27	24.05	98.0	95.7	1.06	20.8	19.6	
	23	24 x 27	24.05	98.9	97.7	1.11	21.8	19.6	
28th	24	24 x 27	24.05	96.3	94.0	1.15	24.0	20.9	
(Oct. '79)	25	27 x 26	24.05	95.7	93.2	1.12	23.0	20.5	
	26	23 x 26	23.23	96.3	94.0	1.11	22.0	19.8	
	27	23 x 26	23.23	96.6	94.8	1.14	22.8	20.0	
	28	23 x 26	23.23	97.4	96.3	1.11	22.4	20.2	
Average			24.02	96.8	94.6	1.12	22.6	20.2	377

Note: Underlined figures are the parents of the next generation.

Table 4. Practical characters on selection of K13

Generation	No.	Lineage	Term 1-5 stage d.h.	Cocoon-ing ratio %	Sound pupa ratio %	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell ratio %	No. of eggs laid
	74	79 x 77	23.23	97.5	93.8	1.13	24.4	21.6	
	75	79 x 77	24.11	96.3	93.5	1.14	24.8	21.8	
	76	79 x 77	23.23	96.9	91.7	1.13	24.4	21 6	
19th	77	79 x 77	23.23	98.8	95.4	1.12	23.4	20.9	
(Jan. '79)	78	79 x 77	24.05	96.3	93.8	1.12	23.8	21.3	
	79	80 x 84	23.23	98.5	96.9	1.16	24.8	21.4	
	80	80 x 84	23.23	98.2	95.4	1.15	24.4	21.2	
	81	80 x 84	23.23	96.6	95.1	1.09	23.6	21.7	
Average			24.01	97.4	94.5	1.13	24.2	21.4	432
	72	79 x 80	22.05	98.0	92.3	1.21	24.4	20.2	
	73	79 x 80	22.05	96.3	87.3	1.23	25.2	20.5	
	74	79 x 80	21.23	96.7	89.7	1.27	26.4	20.8	
20th	75	79 x 80	22.05	96.0	91.7	1.23	25.4	20.7	
(June '79)	76	79 x 80	22.05	95.0	83.3	1.22	25.0	20.5	
	77	76 x 74	22.05	96.3	90.0	1.15	22.6	19.7	
	78	76 x 74	22.05	96.0	91.0	1.15	23.4	20.4	
	79	76 x 74	22.05	94.3	85.7	1.16	23.4	20.2	
Average			22 04	96.1	88.9	1.20	24.5	20.4	345
	41	74 x 75	21.21	91.1	80.3	1.07	21.0	19.6	
	42	74 x 75	20.23	94.6	86.1	1.04	20.0	19.2	
	43	74 x 75	21.23	87.7	79.1	1.11	22.8	20 5	
	44	74 x 75	21.21	84.3	76.3	1.08	22.0	20.4	
	45	74 x 75	21.21	84.3	72.9	1.09	22 6	20.7	
21st	46	74 x 75	21.23	85.0	73.0	1.03	20.0	19.4	
(Aug. '79)	47	74 x 75	21.23	83.1	75.2	1.12	23.6	21.1	
	48	72 x 78	21.21	87.4	75.7	1.10	22.2	20.2	
	49	72 x 78	21.23	89.4	79.7	1.05	21.2	20.2	
	50	72 x 78	21.21	86.0	74.0	1.08	21.6	20.0	
	51	72 x 78	21.21	88.3	80 9	1.04	21.4	20.6	
	52	72 x 78	21.23	86.3	77.7	1.03	20.8	20.2	
	53	72 x 78	21.23	83.7	75.9	1.05	21.4	20.4	
Average			21.20	87.0	77.5	1.07	21.6	20.2	322
	41	45 x 43	22.22	96.8	95.9	1.22	26.2	21.5	
	42	45 x 43	22.23	99.1	96.2	1.19	26 4	22.2	
	43	45 x 43	22.23	97.7	92.6	1.21	26.8	22.2	
	44	45 x 43	23.05	97.4	95.3	1.17	24.4	20.9	
	45	45 x 43	22.23	97.4	91.8	1.22	26.0	21.3	
	46	43 x 51	22.23	97.1	93.8	1.25	27.2	21.8	
22nd	47	43 x 51	22.23	97.4	95.6	1.20	26.0	21.7	
(Oct. '79)	48	43 x 51	22.23	97.4	93.8	1.23	25.4	20.7	
	49	43 x 51	22.23	97.4	94.4	1.24	26.0	21.0	
	50	47 x 51	22.23	97.4	95.0	1.21	25.6	21.2	
	51	47 x 51	22.23	96.8	95.3	1.11	24.6	22.2	
	52	47 x 51	22.23	97.1	90.9	1.20	25.0	20.8	
	53	47 x 53	22.23	97.7	93 8	1.21	25 8	21.3	
	54	47 x 53	22.23	95.6	92.6	1.22	26.8	22.0	
Average			22.23	97 3	94.1	1.21	25 9	21.5	370

Note: Underlined figures are the parents of the next generation

24. Study on the Practical Characters of Chinese Bivoltine Silkworm Strains, K8, K14, K16, and K18

Paiwan LEKUTHAI, Suthathip BUTRACHUND and Sompong KRAIPOT

To raise the productivity of Thai silk, we are carrying out breeding of hybrids bivoltine races instead of Thai polyvoltine ones which cannot spin good cocoons. Continued improvement has produced highly efficient Chinese bivoltine silkworm races K8, K14, K16, K18 etc, using the silkworm varieties sent from Japan or selected from the hybrid of Chinese silkworm strains in our Centre. These Chinese bivoltine races have been improved continuously from the view point of their viability and silk productivity. Using these pure bivoltine races, we succeeded in the breeding of several hybrids which gave us higher productivity than Thai polyvoltine races. And, these hybrids cocoons, produced by farmers, could be reeled by reeling machine to make warp, while Thai polyvoltine cocoons were not successful for it.

This paper dealt with the rearing results of this year for further improvement of these Parent strains (1), (2), (3), (4).

METHOD

Our breeding was started by "cross breeding" and then batch selection was repeated. We have selected for six years (1974 – 1979) on 22 generations for K8, six years (1974 – 1979) on 23 generations for K14, five years (1975 – 1979) on 22 generations for K16, and five years (1975 – 1979) on 20 generations for K18.

The important items in the batch selection were as follows:

1. Uniformity in growth.
2. Stoutness, indicated by high cocooning ratio and sound pupa ratio.
3. Heavy weight of cocoon shell weight and high cocoon shell ratio.
4. Egg laying ability.

RESULT

Results of batch selection of K8, K14, K16 and K18 to be improved are shown in Tables 2-5.

Better batches were selected as the parents of the next generation.

Table 1. Temperature and humidity in rearing room during rearing period.

Rearing season	Temperature (°C)			Humidity (%)
	maximum	minimum	average	
Jan. 1979	34.0	18.0	25.3	70
June 1979	36.5	23.0	28.3	80
Aug. 1979	38.0	22.0	29.2	75
Oct. 1979	35.0	21.5	27.1	74

Table 2. Practical characters on selection of K8

Generation	No.	Lineage	Term 1-5 stage d.h.	Cocoon-ing ratio %	Sound pupa ratio %	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell ratio %	No. of eggs laid
19th (Jan. 18, 1979)	36	41 x 48	24.05	98.0	97.4	1.08	21.8	20.2	
	37	41 x 48	24.05	98.6	97.4	1.11	22.8	20.5	
	38	41 x 48	24.23	94.3	93.7	1.16	24.6	21.2	
	39	41 x 48	24.23	98.3	97.7	1.08	22.2	20.6	
	40	41 x 48	24.05	99.7	98.6	1.10	22.6	20.5	
	41	41 x 48	24.21	98.9	98.9	1.05	22.0	21.0	
	42	45 x 44	24.05	97.4	96.3	1.05	20.6	19.6	
	43	45 x 44	23.20	99.1	98.0	1.12	32.0	20.5	
	44	45 x 44	24.23	98.0	96.6	1.10	22.2	20.2	
	45	45 x 44	24.23	97.4	96.3	1.06	21.0	19.8	
	46	43 x 49	24.23	99.1	98.3	1.10	22.4	20.4	
	47	43 x 49	24.05	98.3	98.0	1.12	23.0	20.5	
Average			24.13	98.1	97.3	1.09	22.4	20.4	463
20th (June 10, 1979)	34	47 x 43	22.05	96.0	93.8	1.07	21.2	19.8	
	35	47 x 43	21.23	96.3	93.5	1.03	18.8	18.3	
	37	47 x 43	22.05	94.5	92.6	1.15	22.4	19.5	
	38	47 x 43	22.05	94.8	92.6	1.09	21.0	19.3	
	39	40 x 37	23.05	96.0	91.4	1.12	21.4	19.1	
	40	40 x 37	22.23	94.8	90.5	1.14	21.2	18.6	
	41	40 x 37	22.23	96.6	93.8	1.13	22.0	19.5	
	42	40 x 37	22.23	97.8	96.9	1.12	21.8	19.5	
	43	38	23.05	95.4	92.0	1.07	20.6	19.3	
	44	38 x 47	22.05	93.8	91.4	1.07	20.4	19.1	
	45	41 x 39	23.05	97.8	95.1	1.12	22.2	19.8	
Average			22.16	95.8	93.1	1.10	21.2	19.3	372
21st (Aug. 15, 1979)	29	45 x 42	21.23	97.0	92.5	1.31	27.0	20.6	
	30	45 x 42	21.05	97.6	93.1	1.32	25.8	19.5	
	31	45 x 42	21.23	93.7	90.1	1.29	26.6	20.6	
	32	45 x 42	21.05	97.3	95.8	1.29	25.6	19.8	
	33	45 x 42	21.05	96.7	92.5	1.32	24.8	18.8	
	34	41 x 34	21.05	94.3	91.6	1.30	24.4	18.8	
	35	41 x 34	21.05	97.3	94.0	1.30	24.8	19.1	
	36	41 x 34	21.05	97.9	97.6	1.34	25.8	19.3	
	37	41 x 34	21.05	96.7	94.3	1.33	25.4	19.1	
	38	37 x 38	21.05	94.9	91.9	1.26	24.4	19.4	
	39	37 x 38	21.05	97.0	92.8	1.37	26.4	19.3	
	40	37 x 38	21.05	96.4	94.3	1.38	26.6	19.3	
Average			21.08	96.4	93.4	1.32	25.6	19.5	482
22nd (Oct. 15, 1979)	29	30 x 36	23.05	97.9	91.9	1.26	25.4	20.2	
	30	30 x 36	23.05	97.6	94.9	1.24	24.6	19.8	
	31	30 x 36	23.05	98.5	94.9	1.30	26.0	20.0	
	32	30 x 36	22.23	98.5	95.8	1.27	25.4	20.0	
	33	30 x 36	22.23	97.0	91.0	1.21	24.4	20.2	
	34	32 x 40	22.23	99.1	97.6	1.24	24.4	19.7	
	35	32 x 40	23.05	97.6	95.5	1.23	24.8	20.2	
	36	32 x 40	23.05	99.1	97.0	1.31	26.8	20.5	
	37	29	22.23	99.4	96.7	1.24	25.6	20.6	
	38	29 x 36	24.05	97.6	93.7	1.26	25.2	20.0	
	39	29 x 36	23.05	98.2	95.8	1.27	25.6	20.2	
	40	29 x 36	23.05	99.1	97.0	1.14	22.8	20.0	
Average			23.05	98.3	95.2	1.25	25.1	20.1	466

Note: Underlined figures are the parents of the next generation.

Table 3. Practical characters on selection of K14

Generation	No.	Lineage	Term 1-5 stage d.h.	Cocoon-ing ratio %	Sound pupa ratio %	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell ratio %	No. of eggs laid
	48	54 x 56	24.21	97.2	96.3	1.08	22.4	20.7	
	49	54 x 56	24.21	99.4	97.8	1.02	20.8	20.4	
20th	50	54 x 56	24.21	99.4	99.1	1.06	21.8	20.6	
(Jan. 18,	51	54 x 56	24.21	97.8	96.9	1.02	20.4	20.0	
1979)	52	55 x 51	24.21	95.4	93.5	1.03	20.6	20.0	
	53	55 x 51	24.21	98.2	96.0	1.03	21.0	20.4	
	54	55 x 51	24.21	98.5	97.8	1.02	20.8	20.4	
	55	58 x 53	24.21	97.5	95.7	1.04	20.6	19.8	
Average			24.21	97.9	96.6	1.04	21.1	20.3	403
	46	48 x 50	23.05	95.1	92.9	1.09	20.6	18.9	
	47	48 x 50	23.05	96.3	94.2	1.14	22.2	19.5	
21st	48	48 x 50	22.23	92.9	91.1	1.10	20.8	18.9	
(June 10,	49	48 x 50	23.05	98.2	93.2	1.20	23.6	19.7	
1979)	50	49 x 54	23.23	96.3	90.5	1.12	22.6	20.2	
	51	49 x 54	23.23	91.1	86.8	1.09	21.0	19.3	
	52	49 x 54	23.05	96.9	90.5	1.07	20.2	18.9	
	53	53 x 51	23.23	96.3	92.0	1.10	21.0	19.1	
Average			23.11	95.4	91.3	1.11	21.5	19.3	326
	54	49 x 47	22.05	88.6	84.6	1.20	23.8	19.8	
	55	49 x 47	22.05	92.3	88 6	1.23	24.8	20.2	
22nd	56	49 x 47	22.05	87.7	76.3	1.11	21.2	19.1	
(Aug. 15,	57	50 x 53	22.05	95.1	92.9	1.23	24.2	19.7	
1979)	58	49	22.05	94.5	91.4	1.34	26.0	19.4	
	59	49 x 50	22.05	86.5	76.6	1.10	20.6	18.7	
	60	50 x 53	22.05	95.7	88.3	1.22	24.2	19.8	
	61	50 x 53	22.05	94.8	87.4	1.15	22.0	19.1	
Average			22.05	91.9	85.8	1.20	23.4	19.5	472
	55	60 x 57	23.05	92.3	87.7	1.03	20.2	19.6	
	56	60 x 57	23.23	98.5	94.8	1.06	21.2	20.0	
23rd	57	60 x 57	23.23	96.0	93.9	1.06	20.8	19.6	
(Oct. 15,	58	55 x 57	23.05	96.3	93.2	1.05	21.0	20.0	
1979)	59	55 x 57	23.05	96.9	91.1	1.02	19.8	19.4	
	60	55 x 57	23.05	98.8	96.3	1.01	19.6	19.4	
	61	57 x 58	23.05	99.4	98.5	1.09	21.2	19.5	
	62	57 x 58	23.23	97.2	93.5	1.10	21.8	19.8	
Average			23.12	96.9	92.8	1.05	20.7	19.7	396

Note: Underlined figures are the parents of the next generation.

Table 4. Practical characters on selection of K16

Generation	No.	Lineage	Term 1-5 stage d.h.	Cocoon-ing ratio %	Sound pupa ratio %	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell ratio %	No. of eggs laid
	56	61 x 67	23.23	98.0	92.3	1.10	22.2	20.2	
	57	61 x 67	24.23	98.0	96.3	1.11	22.2	20.0	
19th	58	61 x 67	24.21	95.7	95.7	1.11	22.2	20.0	
(Jan. 18,	59	61 x 67	24.05	97.7	97.7	1.09	22.0	20.2	
1979)	60	68 x 66	24.05	98.0	98.0	1.03	20.4	19.8	
	61	68 x 66	23.23	98.0	96.7	1.14	22.2	19.5	
	63	68 x 64	23.23	98.7	96 7	1.11	21.8	19.6	
Average			24.07	97.7	96.2	1.10	21.9	19.9	225
	54	59 x 57	22.05	90.7	83.0	0.97	18.6	19.2	
	55	59 x 57	22.05	94.2	86.5	1.00	18.6	18.6	
29th	56	59 x 57	22.05	91.0	88.0	1.06	20.4	19.3	
(June 10,	57	59 x 57	22.21	92.7	91.3	1.09	21.2	19.5	
1979)	58	58 x 63	22.23	97.3	95.7	1.12	21.4	19.1	
	59	58 x 63	21.23	97.7	95.7	1.09	20.6	18.9	
	60	58 x 63	21.23	96.3	94.7	1.16	21.4	18.5	
	61	58 x 63	21.23	98.7	97.7	1.12	21.8	19.5	
Average			22.07	94.8	91.6	1.08	20.5	19.1	275
	62	61 x 58	20.23	94.7	92.7	1.06	20.2	19.1	
	63	61 x 58	20.23	97.3	95.3	1.17	21.6	18.5	
21st	64	61 x 58	20.23	96.0	94.3	1.14	20.4	17.9	
(Aug. 15,	65	61 x 58	20.23	95.3	94 3	1.13	21.8	19.1	
1979)	66	57 x 61	20.23	97.0	96.3	1.18	22.2	18.8	
	67	57 x 61	20.23	95.3	92.7	1.07	19.2	17.9	
	68	57 x 59	20.23	88.7	85.3	1.11	21.0	18.9	
	69	57 x 59	20.23	93.0	91.7	1.25	23.4	18.7	
Average			20.23	94.7	92.8	1.14	21.2	18.6	368
	63	65 x 66	22.23	98.3	97.0	1.14	22.8	20.0	
	64	65 x 66	23.23	99.0	98.0	1.16	22 8	19.7	
22nd	65	65 x 66	21.23	97.3	95.3	1.16	22.6	19.5	
(Oct. 15,	66	66 x 65	22.23	96.7	96.0	1.16	22.4	19.3	
1979)	67	66 x 65	21.23	98.0	97.7	1.15	22.4	19.5	
	68	69 x 63	22.23	96.0	95.3	1.26	23.8	18.9	
	69	69 x 63	22.23	98.0	97.0	1.24	24.0	19.4	
Average			22.20	97.6	96.6	1.18	23.0	19.5	410

Note: Underlined figures are the parents of the next generation.

Table 5. Practical characters on selection of K18

Generation	No.	Lineage	Term 1-5 stage d.h.	Cocoon-ing ratio %	Sound pupa ratio %	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell weight %	No of eggs laid
	64	73 x 72	24.05	98.0	96.9	1.01	22.0	21.8	
	65	73 x 72	24.05	94.0	93.1	0.98	20.8	21.2	
	66	73 x 72	24.05	91.1	90.6	0.93	20.2	21.7	
17th	67	73 x 72	24 05	93.1	92.6	0.99	20.6	20 8	
(Jan, 18,	68	73 x 72	24.05	94.9	93.4	0.99	20.4	20.6	
1979)	69	73 x 72	24.23	96.4	94.6	0.97	19.8	20.4	
	70	74 x 71	24.05	94.0	94.0	1.01	21.6	21.4	
	71	74 x 71	24.23	94.9	94.3	1.00	21.4	21.4	
	72	74 x 71	24.23	91.4	90.3	1.01	21.4	21.2	
	73	74 x 71	24.05	92.9	91.7	0.93	19.2	20.6	
Average			24.10	94.1	93 2	0.98	20.7	21.1	291
	62	64 x 70	22.22	97.9	94.2	1.03	21.6	21.0	
	63	64 x 70	22.22	97.0	92.7	1.03	21.6	21.0	
	64	64 x 70	22.22	92.9	86.8	1.00	21.2	21.2	
18th	65	74 x 70	23.04	93.3	88.5	1.00	21.4	21.4	
(June 10,	66	71 x 65	21.23	95.2	92.4	1.10	22.6	20.5	
1979)	67	71 x 65	21.23	95.2	91.8	1.08	22.4	20.7	
	68	71 x 65	22.05	95.8	93.9	1.06	21.8	20.6	
	69	71 x 65	22.05	96.1	93.9	1.06	21.8	20.6	
	70	71 x 65	22.05	97.3	92.4	1.03	21.2	20 6	
	71	71 x 65	22.05	96.4	92.7	1.10	23.0	20.9	
Average			22.11	95.7	91.9	1.05	21.9	20.9	325
	70	71 x 66	22.05	92.6	81.2	1.09	22.6	20.7	
	71	71 x 66	22.05	92.6	82.1	1.07	21.8	20.4	
	72	71 x 66	22.05	93.5	84.4	1.13	23.4	20.7	
	73	71 x 66	20.23	89.7	76.8	1.06	21.6	20.4	
19th	74	62 x 69	22.05	93.5	82.9	1.08	21.8	20.2	
(Aug. 15,	75	62 x 69	22.05	91.2	81.2	1.12	22.8	20.4	
1979)	76	62 x 69	22.05	89.4	75.3	1.08	21.8	20.2	
	77	62 x 69	21.05	90 6	82.6	1.07	21.8	20.4	
	78	63 x 68	22 03	91.8	81.2	1.09	23.2	21.3	
	79	63 x 68	22.05	90.6	78.2	1.08	22 6	20.9	
	80	63 x 68	22.05	92.6	82.4	1.06	22.6	21.3	
	81	63 x 68	20.23	91.8	80.3	1.10	23.4	21.3	
Average			21.22	91.7	80.7	1.09	22.5	20.7	368
	70	78 x 81	23.05	97.9	96.5	1.10	22.8	20.7	
	71	78 x 81	24.05	97.4	95.9	1.09	22.8	20.9	
	72	78 x 81	23.23	97.9	94.7	1.14	24.2	21.2	
	73	78 x 81	23.05	97.1	93.2	1.12	23.6	21.1	
20th	74	78 x 72	24.05	97.1	92.6	1.16	23.6	20.3	
(Oct. 15,	75	78 x 72	24.05	92.9	89.4	1.09	22.8	20.9	
1979)	76	78 x 72	22.23	91.5	87.1	1.17	24.2	20.7	
	77	72 x 78	23.23	92.1	88.8	1.12	23.8	21.3	
	78	72 x 78	22.23	97.6	94.4	1.15	24 6	21.4	
	79	72 x 78	23.05	96.8	91.2	1.13	23.8	21.1	
	80	70 x 72	23.23	93.8	91.5	1.08	22.0	20 4	
	81	70 x 72	24.05	95.3	91.5	1.11	23.0	20.7	
Average			23.15	95.6	92.2	1.12	23 4	20.9	336

Note: Underline figures are the parents of the next generation.

CONCLUSION

Characteristics of K8, K14, K16 and K18 races are summarized as follows:

K8 is the best Chinese variety now. The good characters are given as under: the highest in viability, high in cocoon shell weight and cocoon shell ratio, easy to rear and uniformity in growth. Egg laying ability is the highest. K8 could be reared in every season and could be brought to make good hybrids.

K14 is high in cocoon shell ratio, but it is not so strong as K8 and K16. From the previous paper of K14 in 1977 (3) and the results of this year, the silkworms seemed to be not comfortable under high temperature condition. Cocoons in shape and size in the hot seasons are not uniform, compared with October rearing. And also, whole cocoon weight in October was as low as in January rearing, while the other races showed higher weights than those in the other seasons. K14, however, could be brought to make good hybrid.

K16 is easy to rear and high in viability, a little lower than K8. Cocoons in shape and size are uniform and cocoon shell ratio is high, too. Only one weak point of K16 is lower in egg laying ability than any other races, but hybrids of K16 are high in viability.

K18 is a sex limited race to be physically weak, but cocoon shell ratio is the highest. The good characteristic is to make us save time in separating male and female. On the other hand, old silkworms ate small amount of mulberry leaves among 4 races, but they could produce high cocoon shells. Egg laying ability of K18 is low because of small pupa, though hybrids of K18 are high in quality and not so poor in their stoutness.

LITERATURE

(1) LEKUTHAI, P. and S. BUTRACHUND: Survey on the practical characters of a new strain of bivoltine silkworm, K14. Bul. Thai Seri. Res. and Train. Centre, No. 6, 1976.

(2) LEKUTHAI, P., S. BUTRACHUND and S. KRAIPOT: Survey on the practical characters of a new strain of bivoltine silkworm, K8. Ibid, No. 7, 1977.

(3) LEKUTHAI, P., S. BUTRACHUND and S. KRAIPOT: Survey on the current parent silkworm races, T, K1, K6, and K14 in 1976. Ibid, No. 7, 1977.

(4) LEKUTHAI, L., S. BUTRACHUND and S. KRAIPOT: Study on the practical characters of two new strains of bivoltine silkworm A10 (K16) and A11 (K18) Ibid, No. 8, 1978.

25. Selection of Pure Japanese and Chinese Silkworm Races from F_1 Bivoltine Hybrids (1)

Paiwan LEKUTHAI, Suthathip BUTRACHUND and Sompong KRAIPOT

Among the current bivoltine silkworm races bred at our section, Chinese races have different characteristics from Japanese ones to be not easy to rear in the Tropics. Some of Japanese races can't be reared under natural condition in Thailand. Especially in our Centre, the air temperature in hot season reaches nearly 40°C which is not suitable for silkworm rearing. The experiment was started to improve Japanese pure races to be enough for better hybrid, using the F_1 hybrids sent from Japan Government. Furthermore, some surveys on their F_2 hybrids and hybrids by hybridization of the F_1 hybrid and our current parent races were carried out preliminarily (1).

METHOD OF BREEDING

The F_1 hybrids, N112 x C110, N122 x C115, and N115 x C108 sent from Japan, were used to start selection. At first the F_1 hybrids were reared and good seed cocoons were selected for F_2 hybrid eggs. F_2 hybrid cocoons were applied to select the advisable Japanese or Chinese race by individual selection. The breeding is to be continued for some years.

Meanwhile, using these hybrids, we started hybridization of the F_1 hybrids with our pure Japanese races K1, K6, and K13. For hybridization of pure Chinese races, K8 and K18 were applied. In breeding, individual selection was repeated by picking up silkworms and cocoons for the characteristic of the respective Japanese and Chinese races. The selection will be continued to find out a few pure races which may be good enough for producing hybrids.

RESULT

Results obtained are shown in Tables 1 – 3.

F_1 hybrids from Japan were high in viability, but their cocoon shell ratio was not so high

(N112 x C110)2 for the selection of pure Japanese and Chinese original races was not good in values of whole cocoon weight, cocoon shell weight and cocoon shell ratio.

The productivity of (N115 x C108)2 was better than (112 x C110)2, but these two respective hybrids with pure Japanese or Chinese races showed the similar results in quantity and quality of cocoons harvested.

(N122 x C115)2 was the highest in whole cocoon weight, cocoon shell weight and cocoon shell ratio. Hybrids interbred with our pure races showed good results.

From the results at the first step of selection and hybridization we hope that among the resulting offsprings we could select any good pure races to make hybrids in the future

LITERATURE

(1) LEKUTHAI, P. and J. JAROONCHAI: Survey on the practical characters of new strains of bivoltine silkworm, K1, K4 and K4a. Bul Thai Seri, Res. and Train, No. 4, 1974.

Table 1. Temperature and relative humidity in rearing room during rearing period

Rearing season	Temperature (°C)			Relative humidity (%) (average)
	maximum	minimum	average	
Aug. 1979	38.0	22.0	29.2	75
Oct. 1979	35.0	21.5	27.1	73

Table 2. Comparison of practical characters of F_1 Hybrids, August, 1979

Race	Term 1-5 stage d.h.	Cocoon-ing ratio %	Sound pupa ratio %	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell ratio %
N112 x C110	20.21	98.7	97.0	1.30	22.8	17.5
	20.21	98.7	97.3	1.32	22.4	17.0
	20.21	97.7	97 0	1.40	24.0	17.1
	20.21	98.7	98 7	1.33	22.8	17.1
Average	20.21	98.5	97.5	1.34	23.0	17.2
N122 x C115	20.05	99.3	97 3	1 52	27.6	18.2
	19.23	98.3	97.7	1.53	27.8	18.2
	19.23	98.0	97.0	1.51	27.0	17.9
	19.23	97.7	97.0	1.52	27.6	18.2
Average	20.01	98.3	97.3	1.52	27.5	18.1
N115 x C108	21.05	98.0	97.0	1.50	29.6	19.7
	20.23	98.7	97.0	1.50	29.2	19.5
	20.23	98.3	96.7	1.56	30.8	19.7
	21.23	99.3	98.7	1.63	33.6	20.6
Average	21.07	98.6	97.4	1.55	30.8	19.9

Table 3. Comparison of practical characters at the beginning of selection and the results of hybridization, October, 1979

Race	Selected from	Term 1-5 stage d h.	Cocoon-ing ratio %	Sound pupa ratio %	Whole cocoon weight g	Cocoon shell weight cg	Cocoon shell weight %
S1+S2	(N112xC110)2	22.23	99.0	98.0	1.03	16.6	16.1
S3	(N112xC110)K1	22.05	99.3	98.0	1.29	23.2	18.0
S4	(N112xC110)K8	22.23	99.3	98.7	1.30	25.2	19.4
S5	(N112xC110)K6	22.23	99.3	99.0	1.43	28.0	19.6
S6	(N112xC110)K18	21.23	99.3	97.0	1.31	25.2	19.2
S7	(N112xC110)K13	21.23	99.3	99.0	1.47	28.8	19.6
S9+S10	(N122xC115)2	25.23	95.0	86.0	1.33	25.0	18.8
S11	(N122xC115)K1	22.23	99.7	99.3	1.38	27.8	20.1
S12	(N122xC115)K8	22.21	97.7	94.3	1.35	27.4	20.3
S13	(N122xC115)K6	23.23	96.0	92.7	1.47	30.0	20.4
S14	(N122xC115)K18	23.05	98.3	97.7	1.37	28.0	20.4
S15	(N122xC115)K13	22.23	97.0	95.7	1.47	32.2	21.9
S17+S18	(N115xC108)2	24.23	98.0	94.7	1.22	23.0	18.9
S19	(N115xC108)K1	23.05	96.5	93.2	1.29	23.6	18.3
S20	(N115xC108)K8	22.23	97.0	95.0	1.25	24.0	19.2
S21	(N115xC108)K6	23.05	97.7	94.7	1.29	24.6	19.1
S22	(N115XC108)K18	22.23	97.7	97.0	1.25	24.0	19.2
S23	(N115xC108)K13	22.23	99.3	98.3	1.31	26.0	19.9

26. Survey on the Practical Characters of Several F_1 Hybrids of Bivoltine Silkworm Races (9)

Parn PANNENGPET and Charuk PRA-AIPAN

Some surveys on the practical characters of F_1 hybrids among several races were pursued as same as the previous years (1), (2), (3), (4), (5), (6), (7), (8).

MATERIALS AND METHODS

Surveying was done 4 times in 1979 on several F_1 hybrids as follows:

1st surveying, January 1979, on 13 F_1 hybrids
2nd surveying, June 1979, on 20 F_1 hybrids
3rd surveying, August 1979, on 27 F_1 hybrids
4th surveying, October 1979, on 21 F_1 hybrids

In each survey, young silkworms from several batches per hybrid were reared, mixed together. At the beginning of the fourth stage, the number of worms were reduced to the basic number, usually containing 400 in a tray of each hybrid.

Principal items to be measured, calculated, and observed were as follows:

1. Term from 1st to 5th stage
2. Viability represented by sound pupa ratio which was calculated from the basic number at the beginning of the fourth stage.
3. Whole cocoon weight
4. Cocoon shell weight
5. Cocoon shell ratio
6. Uniformity in growth of worms and shape of cocoons including uniformity in shape and size of them.

RESULT

The results are shown in Tables 1 and 2.

In the first survey, January, all of 13 hybrids showed high degree of viability which was represented by sound pupa ratio, ranging from 98.3% to 94.7%. In this season the varietal difference of viability could be hardly recognized for judging their practical characters. On the qualities of cocoons, after fine screening, K6 x K14 was slightly better than K6 x E28, K13 x K8, and K13 x K16.

In August, the best among 27 hybrids was N x C, a commercial hybrid produced by Thai Food and Drink Co., Ltd. This variety showed high qualities of cocoon, although its stoutness was somewhat lower than the hybrids produced by the Center. Also, in this survey, fortunately, there were 3 F_1 hybrids, sent from Japanese Government, to be compared with hybrids produced in Thailand. Unsatisfactorily, none of them showed good results. Among hybrids produced by our Breeding Section, the results of the experiment in August showed that E25, a Japanese line, always raised up the stoutness of the hybrids, if composed of, but it showed not so good results in cocoon qualities. Meanwhile, the hybrids composed of K6 gave the contrary results. In the last survey, carried out in October, the results were fluctuated in a difficult position to be unable to screen better combinations. K13 x K18, however, seemed to be better than the others among 21 hybrids, followed by K1 x K18 and K8 x K1.

DISCUSSION

According to the results in 1979, K13 x K18 was a hybrid which gave a satisfactory result. It may be noticed that E25, a new race, seemed to show high hybrid vigor in stoutness, if composed of.

LITERATURE

(1) PANNENGPET, P. and K. KOMUTANON: Survey on the practical characters of several F_1 hybrids of bivoltine silkworm races. Bul. Thai. Seri. Res. and Train. Centre, No. 2, 1972.

(2) PANNENGPET, P. and K. KOMUTANON: Ditto (2), Ibid, No. 3, 1973.

(3) PANNENGPET, P.: Ditto (3). Ibid., No. 4, 1974.

(4) PANNENGPET, P. and J. JAROONCHAI: Ditto (4). Ibid. No. 5, 1975.

(5) PANNENGPET, P. and J. PEUNGARSRAI: Ditto (5). Ibid. No. 6, 1976.

(6) PANNENGPET, P., J. PEUNGARSRAI and P. PIMPRAPAPORN: Ditto (6). Ibid. No. 7, 1977.

(7) PANNENGPET, P., P. PIMPRAPORN and C. PRA-AIPAN: Ditto (7). Ibid. No. 8, 1978.

(8) PANNENGPET, P. and C. PRA-AIPAN: Ditto (8). Ibid. No. 9, 1979.

Table 1. Comparison of practical characters of F_1 hybrids

Season	Hybrids	Term 1-5 stage day	Sound pupa ratio %	Cocoon Whole wheight g	Shell weight cg	Shell ratio %	Remarks
January 1979	K1xT	25	97.0	1.35	24.9	18.4	
	K1xK8	25	94.7	1.25	25.8	20.6	
	K1xK14	26	96.3	1.20	23.9	19.9	
	K1xK16	25	94.7	1.24	24.9	20.1	
	K1xK18	24	97.1	1.24	26.3	21.1	
	K6xT	24	96.5	1.37	26.9	19.6	
	K6xK8	26	96 3	1.32	28.8	21.8	
	K6xK14	26	95.7	1.37	30.7	22.4	
	K6xK16	26	96.7	1.34	29.4	21.9	
	K6xK18	25	98.7	1.31	27.3	20.8	
	K13xT	24	97.4	1.37	26.4	19.3	
	E25xT	24	98.0	1.43	27.5	19.2	
	E25xE28	24	98.0	1.24	23.4	18.9	
June 1979	K1xT	19	97.3	1.44	26.6	18.5	
	K1xK8	20	93.3	1.55	31.3	20.2	
	K1xK16	20	90.3	1.65	33.1	20.0	
	K1xK18	20	89.7	1.53	31.5	20.6	
	K1xE28	21	91.1	1.50	31.9	21.3	
	K6xK16	21	92.0	1.55	33.0	21.3	
	K6xK18	21	95.5	1.52	33.6	22.1	
	K6xE28	20	96.5	1.57	33.3	21.2	
	K13xT	19	96.7	1.59	32.0	20.1	
	K13xK8	20	94.0	1.64	35.3	21.6	
	K13xK14	20	91.3	1.67	35.3	21.1	
	K13xK16	20	93.0	1.65	34.6	21.0	
	K13xK18	20	92.3	1.51	32.6	21.6	
	K13xE28	21	87.3	1.21	26.0	21.5	
	E25xT	19	95.7	1.39	25.9	18.6	
	K8xE25	20	94.3	1.48	30.0	20.3	
	E25xK14	20	89.0	1.42	29.7	20.9	
	E25xK16	20	96.0	1.47	29.9	20.4	
	E25xK18	20	93.3	1.51	31.2	20.7	
	E25xE28	19	97.3	1.34	26.6	19.8	
August 1979	K1xT	20	95.0	1.35	25.5	18.9	
	K8xK1	20	86.0	1.46	30.0	20.6	
	K1xK16	20	95.7	1.36	27.8	20.4	
	K1xK18	20	93.5	1.43	30.8	21.5	
	E28xK1	20	95.3	1.41	27.7	19.6	
	K6xK16	21	96.0	1.57	34.0	21.7	
	K6xK18	21	91.3	1.56	35.6	22.8	
	K6xE28	21	84.0	1.59	34.2	21.5	
	K13xT	20	92.0	1.47	29.5	20.1	
	K13xK14	20	91.7	1.56	34.6	22.2	

Season	Hybrids	Term 1-5 stage day	Sound pupa ratio %	Cocoon			Remarks
				Whole wheight g	Shell weight cg	Shell ratio %	
August 1979	K13xK16	20	94.0	1.56	33.0	21.2	
	K13xK18	20	96.3	1.47	33.1	22.5	
	K13xE28	20	93.3	1.51	31.7	21.0	
	E25xT	20	94.3	1.42	25.9	18.2	
	E25xK8	20	95.7	1.45	29.6	20.4	
	K14xE25	20	95.7	1.46	30.4	20.8	
	E25xK16	20	97.6	1.39	28.3	20.4	
	E25xK18	20	96.3	1.42	29.4	20.7	
	E22xE10	20	95.7	1.48	29.4	19.9	
	E10xE28	21	94.7	1.55	29.7	19.2	
	E22xE25	20	95.3	1.47	30.6	20.8	
	E28xE25	20	96.3	1.38	28.0	20.3	
	NxC	21	94.6	1.81	44.0	24.3	Commercial eggs from Thai Food & Drink Co. Ltd.
	CxN	21	91.0	1.62	38.8	24.0	
	N112xC110	20	96.5	1.43	26.6	18.6	Introduced from Japan
	N122xC115	21	86.7	1.61	34.2	21.2	
	N115xC108	20	86.3	1.57	30.3	19.3	
October 1979	K1xT	22	93.3	1.10	19.3	17.5	
	K8xK1	24	97.3	1.14	22.7	19.9	
	K1xK16	24	90.3	1.13	21.8	19.3	
	K1xK18	23	93.7	1.27	26.4	20.8	
	K1xE28	24	95.7	1.18	23.9	20.3	
	K6xK16	24	91.0	1.37	28.8	21.0	
	K6xK18	25	92.3	1.28	26.6	20.8	
	E28xK6	24	94.7	1.19	24.2	20.3	
	K13xT	22	95.0	1.21	22.0	18.2	
	K13xK14	24	91.0	1.34	29.2	21.8	
	K13xK16	24	90.2	1.27	27.0	21.3	
	K13xK18	24	96.2	1.28	27.4	21.4	
	K13xE28	24	84.3	1.16	23.4	20.1	
	E25xT	23	82.3	1.22	21.8	17.9	
	E25xK14	24	85.0	1.25	24.4	19.5	
	E25xK16	24	92.3	1.23	24.6	20.0	
	E25xK18	24	84.3	1.23	24.8	20.2	
	E10xE22	24	93.2	1.43	27.3	19.1	
	E28xE10	25	97.0	1.32	25.4	19.2	
	E22xE25	24	93.3	1.21	24.1	19.9	
	E25xE28	24	86.0	1.17	22.7	19.4	

Table 2. Temperature and relative humidity in rearing room during rearing season

Season	Temperature °C			Relative humidity %
	Maximum	Minimum	Average	
January 1979	36.0	18.5	26.2	72
June	35.0	24.5	28.8	79
August	36.5	25.5	30.0	75
October	33.0	21.0	26.2	72

27. Survey on the Practical Characters of Several F_2 Hybrids of Bivoltine Silkworm Races (9)

Parn PANNENGPET and Charuk PRA-AIPAN

Successively, in order to progress the program to distribute the bivoltine silkworm eggs of F_2 hybrid among farmers, survey on the practical characters of F_2 hybrids of several races was pursued to find out the best combination of F_2 hybrids (1), (2), (3), (4), (5), (6), (7), (8).

MATERIALS AND METHODS

Survey was done 3 times in 1979 on several F_2 hybrids as follows:

1st surveying, June 1979, on 5 F_2 hybrids
2nd surveying, August 1979, on 5 F_2 hybrids
3rd surveying, October 1979, on 7 F_2 hybrids

In each survey, young silkworms from several batches of each of hybrids were reared, mixed together. At the beginning of the fourth stage, the number of worms were reduced to the basic number, usually containing 400 in a tray of each hybrid.

Principal items to be measured, calculated, and observed were the same as in the survey on hybrid F_1.

RESULTS

The results are shown in Tables 1 and 2.

In the first, second, and third surveying, three times done in 1979, there were 2 combinations of F_2 hybrid, $(K1 \times T)_2$ and $(E25 \times E28)_2$, which showed nearly equable results throughout the surveying. $(K1 \times T)_2$ showed inferior results to $(E25 \times E28)_2$ in both characters, stoutness and cocoon qualities.

DISCUSSION

$(K1 \times T)_2$ showed the similar results in its stoutness and cocoon qualities as those in the previous years. So, $(K1 \times T)_2$ may be available in F_1 hybrid's place among sericultural farmers, if the program of F_2 eggs distribution could be continued. However, the survey on the practical characters of other F_2 hybrids must be continued to find out better combination of F_2 hybrid that gave slightly different results from the parent F_1 hybrid. And, $(E25 \times E28)_2$ may be regarded as one of the most interested F_2 hybrids.

LITERATURE

(1) PANNENGPET, P. and K. KOMUTANON: Survey on the practical characters of several F_2 hybrids of bivoltine silkworm race. Bul. Thai. Seri. Res. and Train. Center, No. 2, 1972.
(2) PANNENGPET, P. and K. KOMUTANON: Ditto (2) Ibid. No. 3, 1973.
(3) PANNENGPET, P. and J. JAROONCHAI: Ditto (3) Ibid. No. 4, 1974.
(4) PANNENGPET, P. and J. JAROONCHAI· Ditto (4) Ibid. No. 5, 1975.
(5) PANNENGPET, P. and J. PEUNGARSRAI: Ditto (5) Ibid. No. 6, 1976.
(6) PANNENGPET, P., J. PEUNGARSRAI and P. PIMPRAPAPORN: Ditto (6) Ibid No. 7, 1977.

(7) PANNENGPET, P. P. PIMPRAPAPORN and C. PRA-AIPAN: Ditto (7) Ibid. No. 8, 1978.
(8) PANNENGPET, P. and C. PRA-AIPAN: Ditto (8) Ibid. No. 9, 1979.

Table 1. Comparison of practical characters of F_2 hybrids

Season	Hybrids	Term 1 - 5 stage day	Sound pupa ratio %	Cocoon whole wt. g	Cocoon shell wt. cg	Cocoon shell ratio %	Remarks
January 1979	omitted						
June 1979	(K1 x T)2	20	88.3	1 19	25.0	21 0	
	(K1 x K18)2	20	85.7	1 37	26.8	19.5	
	(K6 x K18)2	21	83.3	1.32	26.9	20.3	
	(K13 x T)2	20	82.0	1.32	24.1	18.3	
	(E25 x E28)2	21	87.3	1.24	23.6	19.0	
August 1979	(K1 x T)2	20	91.7	1.37	25.0	18 4	
	(K1 x K18)2	20	84.3	1.46	28.7	19.7	
	(K6 x E28)2	21	88.0	1.38	28.3	20.5	
	(K13 x T)2	20	86.7	1.49	27.8	18.7	
	(E25 x E28)2	20	96 8	1.36	26.1	19.2	
October 1979	(K1 x T)2	23	88.7	1.09	18.6	17.1	
	(K6 x E28)2	25	89.3	1.33	26.7	20.1	
	(K13 x K18)2	24	89.8	1 17	24.2	20.7	
	(E28 x E25)2	24	89.5	1.19	22.7	19.1	
	(N112 x C110)2	23	90.3	1.07	18.6	17.3	
	(N122 x C115)2	26	82.0	1.29	24.9	19.3	
	(N115 x C108)2	25	81 3	1.16	19.6	16.9	

Table 2. Temperature and relative humidity in rearing room during rearing season

Season	Temperature (°C)			Relative humidity (%)
	maximum	minimum	average	
January 1979		omitted		
June	35.0	24.5	28.8	79
August	36.5	25.5	30.0	75
October	33 0	21.0	26.2	72

28. Survey on the Practical Characters of Double Cross Hybrids of Bivoltine Silkworm Races (7)

Parn PANNENGPET and Charuk PRA-AIPAN

Double cross hybrid is a practical kind of hybrids in the sericultural practice. This kind of hybrid, if suitable pairs of F_1 hybrids are raised, would produce cocoons in the similar ability as F_1 hybrid. Also, double cross hybrid is considered hopeful for silkworm egg distribution to farmers besides F_1 and F_2 hybrids. In addition, egg production of double cross hybrids is easier than that of F_1 hybrids, because F_1 hybrids as the parents of double cross hybrids are stronger than the pure races for F_1 hybrid egg production. And, parents of double cross hybrids are easier in rearing of worms, higher in percentage of moth emergence, and higher in reproductivity of eggs per moth than parents of F_1 hybrids (1), (2), (3), (4), (5), (6).

MATERIALS AND METHODS

Surveying was done 4 times in 1979 with several combinations of double cross hybrids as follows:

1st surveying, January 1979, on 1 combination
2nd surveying, June 1979, on 10 combinations
3rd surveying, August 1979, on 12 combinations
4th surveying, October 1979, on 13 combinations

In each survey, young silkworms from several batches per combination were reared, mixed together. At the beginning of the fourth stage, the number of worms was reduced to the basic number, usually containing 400 in a tray of each combination.

Principal items to be surveyed or observed for judging the practical values of the hybrids are the same as in the cases of hybrid F_1 and F_2.

RESULTS

The results of the survey are shown in Tables 1 and 2.

In the furst survey, only one three-way cross hybrid was examined. This hybrid is a combination of F_1 hybrid, KINSHU x SHOWA, imported from Japan, with Thai native race, Nongkai 4 (NK4). This kind of hybrid gave unsatisfactory results. Rearing of larvae was very difficult, caused by bad uniformity of growth. Also, they produced uneven cocoons in size and shape. Nevertheless, this hybrid gave reportedly better result than Thai native pure races.

In the second survey, among all of double cross hybrids, derived from common F_1 hybrids in the Center, the best combination was (K1.T) x (K6.K18), followed by (K1.K18) x (E15.E28) and (K6.T) x (K1.K18). In the third survey, carried out in August, (K13.E25) x (K8.K18) showed slightly better results than (K13.E25) x (K16.K18) and (K16.K18) x (K1.K6). In October, the last survey, (K18.K16) x (K6.K1) was the best among 13 combinations Other hybrids, followed the combination, were (K18.K16) x (K13.K1) and a three-way cross hybrid, (K8.K18) x K13, with almost the same results.

DISCUSSION

In the surveys, carried out in 1979, most of double cross hybrids showed better results, compared with the previous years, having abilities to be not far from F_1 hybrid.

As a result, it may be said that the pairs of F_1 hybrids were suitably combined. However, further trials with double cross hybrids must be pursued on to find the better combinations of F_1 hybrid, composed of such pure races as K1, K6, K8, K13, K16, K18, and E25.

LITERATURE

(1) PANNENGPET, P.: Survey on the practical characters of three-way cross and double cross hybrids of bivoltine silkworm races. Bul. Thai Seri. Res. and Train. Centre, No. 3, 1973.

(2) PANNENGPET, P.: Survey on the practical characters of double cross hybrids of bivoltine silkworm races. Ibid. No. 4, 1974.

(3) PANNENGPET' P.: Ditto. (2) Ibid. No. 5, 1975.

(4) PANNENGPET, P. and J' PEUNGARSRAI: Ditto (3). Ibid. No. 6, 1976.

(5) PANNENGPET, P., J. PEUNGARSRAI and P. PIMPRAPAPORN: Ditto (4), Ibid. No. 7, 1977.

(6) PANNENGPET, P., P. PIMPRAPAPORN and C. PRA-AIPAN: Ditto (5). Ibid. No. 8, 1978.

(7) PANNENGPET, P. and C. PRA-AIPAN: Ditto (6). Ibid No. 9, 1979.

Table 1. Comparison of practical characters of three-way and double cross hybrids

Season	Hybrids	Term 1 – 5 stage day	Sound pupa ratio %	Cocoon whole wt g	Cocoon shell wt. cg	Cocoon shell ratio %	Remarks
January 1979	(KINSHU.SHOWA) x NK4	25	88.0	1.12	20.0	17.9	
June 1979	(K1.T) x (K6.K18)	20	95.7	1.54	30.6	19.9	
	(K1.T) x (E25.E28)	19	83.2	1.44	26.1	18.1	
	(K6.T) x (K1.K18)	20	93.7	1.49	29.5	19.8	
	(K6.T) x (E25.E28)	20	84.0	1.49	28.8	19.3	
	(K13.T) x (K1.K18)	20	89.7	1.48	29.0	19.6	
	(K13.T) x (K.K18)	20	85.3	1.51	30.6	20.3	
	(K13 T) x (E25.E28)	19	82.2	1.39	26.4	19.0	
	(E25.T) x (K1.K18)	20	92.3	1.37	26.4	19.3	
	(E25.T) x (K6.K18)	20	94.7	1.42	28.0	19.7	
	(K1.K18) x (E25.E28)	19	97.3	1.42	28.3	19.9	
August 1979	(K16.K18) x K1	20	93.0	1 48	30.2	20.4	
	(K13.E25) x T	19	89.3	1.46	27.3	18.7	
	(K1.T) x (K6.K18)	20	94.6	1.55	32.2	20.8	
	(K6.K18) x (E25.T)	20	95.3	1.45	29.3	20.2	
	(E25.T) x (K1.K18)	20	90.9	1.38	27.1	19.6	
	(E25.E28) x (K1 T)	20	94.3	1.31	24.6	18.8	
	(K1.K6) x (K8.K18)	20	90.0	1.50	31.6	21.1	
	(K16.K18) x (K1.K6)	20	94.8	1.60	33.4	20.9	
	(K1.K4) x (K8.K18)	20	84.0	1.37	28.9	21.1	
	(K1.K4) x (K16.K18)	20	90.0	1.46	30.0	20.5	
	(K13.E25) x (K8.K18)	20	95.5	1.57	33.7	21.5	
	(K13.E25) x (K16.K18)	20	96.7	1.49	32.3	21.7	
October 1979	(K13.K1) x K8	24	93.7	1.26	25.7	20.4	
	(K13.K1) x K18	24	92.0	1.27	26.1	20.6	
	(K8 x K18) x K1	25	96.3	1.21	24.3	20.1	
	(K8.K18) x K13	24	94.7	1.37	28.9	21.3	
	(E28.E25) x (K1.T)	23	92.3	1.07	26.1	18.8	
	(K13.T) x (K1.K18)	24	93.6	1.20	23.1	19.3	
	(K1.K18) x (K6.E28)	24	97.3	1.30	26.3	20.2	
	(K8.K18) x (K6.K1)	25	91.3	1.31	26.9	20.5	
	(K18.K16) x (K6.K1)	24	96.3	1.33	27.0	20.3	
	(K8 K18) x (K13.K1)	25	95.3	1 28	26.2	20.5	
	(K18.K16) x (K13.K1)	25	95 2	1 37	26.7	20.4	
	(K8.K18) x (K13.E25)	24	94.0	1.28	25.8	20.2	
	(K18.K16) x (K13.E25)	24	97.3	1.28	26.8	20.9	

Table 2. Temperature and relative humidity in rearing room during rearing season

Season	Temperature (°C)			Relative humidity (%)
	maximum	minimum	average	
January 1979	36.0	18.5	26.2	72
June	35.0	24.5	28.8	79
August	36.5	25.5	30.0	75
October	33.0	21.0	26.2	72

29. Survey on the Period of Larval and Pupal Stages of the Main Silkworm Races in the Centre (6)

Peerapong CHAOSATTAKUL, Noppadon PANKUMKERD
and Wichian POCHINNARONG

For the mass production of F_1 hybrid, it is the most important matter to be well acquainted with the length of period from "HAKITATE" to moth emergence from cocoon relative to both the parent races crossed. Because the growth of them must be controlled so as to emerge out on the same day, followed by regulation of the larval and pupal states in every rearing season.

The survey in the last year was successively pursued, using the available silkworm races including a new strain.

Races	Season
K1, K8, K18	January 1979
K1, K8, K18	June 1979
K1, K8, K18	August 1979
K1, K13, K8, K18	October 1979

Furthermore, the practical combinations of crossing for F_1 hybrid by these parent races are K1 x K8 (or K8 x K1), K1 x K18 (or K18 x K1), K13 x K8 (or K8 x K13) and K13 x K18 (or K18 x K13).

RESULTS AND CONCLUSION

The results obtained are shown in Tables 1 – 4 and summarized as follows:

1. The varietal differences among K1 or K13 (both Japanese races) and two Chinese races, K8 and K18, were 0.5 – 1 day in the total period of larval and pupal stages, in compliance with the rearing season.

2. In the cases of K8 and K18 races, there was 0.5 – 1 day's difference between the total period of the larval and pupal stages of them.

3. The varietal difference among K1 (a Japanese race) and K8, or K18 (both Chinese races) was 1 – 1.5 days in the total period of the larval and pupal stages by season.

4. The varietal difference among K13 (a Japanese race) and K8 or K18 (both Chinese races) was about two days by season.

These similar results as in the previous years proved that the moths of two races to be crossed shall emerge on the same day by the adjustment of "HAKITATE".

LITERATURE

(1) BUACHOOM, K.: Rocord on the growth period of K1 and T. Bul. Thai Seri. Res. and Train. Centre, No. 4, 1974.
(2) BUACHOOM, K.: Survey on the period of larval and pupal stages of the main silkworm races in the Centre. Ibid. No. 5, 1975.

(3) BUACHOOM, K. and P. CHAOSATTAKUL: Ditto, Ibid. No. 6, 1976.
(4) CHAOSATTAKUL, P., D. HARNKITCHANURUK and U. SUWANTADA: Ditto. Ibid. No. 7, 1977.
(5) CHAOSATTAKUL, P., D. HARNKITCHANURUK: Ditto. Ibid. No. 8, 1978.
(6) CHAOSATTAKUL, P., K. BUACHOOM and D. HARNKITCHANURUK: Ditto. Ibid. No. 9, 1979.

Table 1. Amount of leaves supplied (1979)

Race		K1				K13
Season		January	June	August	October	October
Stage 1	Feeding term	3.06	3.01	2.20	3.01	3.01
	Sleeping term	1.00	1.00	1.00	1.00	1.00
	Total	4.06	4.01	3.20	4.01	4.01
	Temp. (°C)	27.5	29.2	29.4	26.9	27.6
	Hum. (%)	64	71	73	67	67
2	Feeding term	2.19	2.05	2.05	2.05	2.05
	Sleeping term	1.05	1.00	1.00	1.00	1.00
	Total	4.00	3.05	3.05	3.05	3.05
	Temp. (°C)	28.1	28.8	25.5	27.0	26.6
	Hum. (%)	62	75	72	64	71
3	Feeding term	3,00	2.14	2.00	2.19	2.19
	Sleeping term	1.14	1.05	1.05	1.05	1.00
	Total	4.14	3.19	3.05	4.00	3.19
	Temp. (°C)	27.3	29.0	29.9	26.3	24.4
	Hum. (%)	64	80	69	71	73
4	Feeding term	3.10	3.00	3.00	3.00	3.05
	Sleeping term	1.19	1.19	1.14	1.14	1.14
	Total	5.05	4.19	4.14	4.14	4.19
	Temp. (eC)	26.5	28.8	29.9	28.5	28.3
	Hum. (%)	63	72	68	72	73
5	Feeding term	6.23	6.05	6.05	6.08	7.00
	Sleeping term	–	–	–	–	–
	Total	6.23	6.05	6.05	6.08	7.00
	Temp. (eC)	27.1	28.5	29.0	26.3	27.6
	Hum. (%)	61	71	75	70	73
Total Stage	Feeding term	19.10	17.01	16.06	17.09	18.06
	Sleeping term	5.14	5.00	4.19	4.19	4.14
	Total	25.00	22.01	21.01	22.04	22.20
	Temp (°C)	27.3	28.9	28.7	27.0	26.9
	Hum. (%)	63	74	71	70	71

Table 2. Period of larval stage (2) (1979)

Race		K8				K18			
Season		January	June	August	October	January	June	August	October
Stage 1	Feeding term	3.06	3.01	2.20	3.06	3.20	3.01	3.06	3 06
	Sleeping term	1.00	1.05	1.00	1.00	1.00	1.00	1.00	1 00
	Total	4.06	4.06	3.20	4.06	4.20	4 01	4.06	4 06
	Temp. (°C)	27.2	29.0	28.9	27.4	26.8	29.3	29.6	27.4
	Hum. (%)	64	74	72	61	65	70	69	63
2	Feeding term	3.00	2.00	2.05	2.00	2.10	2.05	2.00	2 19
	Sleeping term	1.00	1.00	1.00	1.00	1.14	1.00	1.00	1 05
	Total	4.00	3.00	3.05	3.00	4.00	3.05	3.00	4.00
	Temp. (°C)	27.9	29.2	28 8	26.6	27.0	28.3	29.7	26.2
	Hum. (%)	62	79	73	66	66	78	69	71
3	Feeding term	2.14	2.00	2.19	2.19	2.10	2.14	2.19	2 00
	Sleeping term	1.00	1.00	1.00	1.05	1.19	1.05	1.05	1.14
	Total	3.14	3.00	3.19	4.00	4.05	3.19	4.00	3.14
	Temp. (°C)	27.5	29.7	30.3	28.3	26.7	29.0	30.3	28.3
	Hum. (%)	63	77	67	75	65	80	67	74
4	Feeding term	4.10	3.00	2.10	3.00	3.05	3.00	3.05	3.10
	Sleeping term	1.14	1.14	1.14	1.19	2.14	1.19	1.04	1.14
	Total	6.00	4.14	4.00	4.19	5.19	4.19	4.09	5.00
	Temp. (°C)	26.5	28.0	28.8	27.4	27.0	28.8	29.9	27.0
	Hum. (%)	63	76	79	73	62	72	69	73
5	Feeding term	7.09	6.10	6.05	6.19	6.10	6.05	6.20	7.05
	Sleeping term	–	–	–	–	–	–	–	–
	Total	7.09	6.10	6.05	6.19	6.10	6.05	6.20	7.05
	Temp. (°C)	27.1	28.5	28.6	26.4	27.9	28.5	29.1	26.4
	Hum. (%)	64	82	72	69	64	71	71	69
Total stage	Feeding term	20.15	16.11	16.11	17.20	18.07	17.01	18.02	18 16
	Sleeping term	4.14	4.19	4.14	5.00	6.23	5.00	4.09	5.09
	Total	25.05	21.06	21.01	22.20	25.06	22.01	22.11	24.01
	Temp. (°C)	27.2	28.9	29.1	27.2	27.1	28.8	29.7	27 1
	Hum. (%)	63	78	72	69	64	74	69	70

Table 3. Period of pupal stage (1979)

	Race	K1				K13
	Season	Jan.	June	Aug.	Oct.	Oct.
Pupal stage	Date of mount.	Feb. 8	June 30	Sept. 4	Nov. 4	Nov. 4
	Date of emerg.	Feb. 21	July 11	Sept. 17	Nov. 20	Nov. 20
		d.h.	d.h.	d.h.	d.h.	d.h.
	Term	12.17	11.19	12.20	15.16	15.16
	Temp. (°C)	28.0	28.7	28.9	26.2	26.5
	Hum. (%)	61	73	73	67	71

	Race	K8				K18			
	Season (1979)	Jan.	June	Aug.	Oct.	Jan.	June	Aug.	Oct.
Pupal stage	Date of mount.	Feb. 9	July 1	Sept. 6	Nov. 8	Feb. 10	June 30	Sept. 7	Nov. 8
	Date of emerg.	Feb. 21	July 14	Sept. 18	Nov. 21	Feb. 22	July 12	Sept. 18	Nov. 21
		d.h.	d.h.	d.h.	d.h.	d.h.	d h.	d.h.	d.h.
	Term	11.17	12.18	11.20	12.18	11.18	11.19	10.16	12.16
	Temp. (°C)	27.7	29.5	28.7	26.3	29.3	28.2	28.5	26.0
	Hum. (%)	61	67	74	64	59	63	80	65

Table 4. Period from "HAKITATE" to moth emergence (1979)

Race	K1				K13
Season	Jan.	June	Aug.	Oct	Oct.
	d.h.	d.h.	d.h.	d.h.	d.h.
Period of larval stage	25.00	22.01	21 01	22.04	22.20
Period of pupal stage	12.17	11.19	12.20	15.16	15.16
From "HAKITATE" to moth emergence	37.17	33.20	33.21	37.20	38.12

Race	K8				K18			
Season	Jan.	June	Aug.	Oct.	Jan.	June	Aug.	Oct.
	d.h.	d.h.	d.h.	d.h.	d h.	d.h.	d.h.	d.h.
Period of larval stage	25.05	21.06	21.01	22.20	25.06	22.01	22.11	24.01
Period of pupal stage	11.17	12.18	11.20	12.18	11.18	11.19	10.16	12.16
From "HAKITATE" to moth emergence	36.22	34.00	32.21	35.14	37.00	33.20	33.03	36.17

30. Survey on the Amount of Food for the Main Silkworm Races in the Centre (6)

Peerapong CHAOSATTAKUL, Noppadon PANKUMKERD
and Wichian POCHINNARONG

In order to make a plan of silkworms eggs production, the necessary quantity of mulberry leaves for the parent silkworms, which will produce the intended quantity of silkworm eggs, must be made preparations in advance.

For the purpose, the similar survey as the last five years (1), (2), (3), (4), and (5) was carried out, using some popular races and a new strain in the Centre. Daily amount of supplied mulberry leaves was recorded in order to arrange the amount of food to a unit batch of silkworms.

MATERIAL AND METHOD

1. Silkworm race reared: K1, K8, K18, and K13

2. Rearing season:

   K1, K8, and K18 . . . . January, June, August, and October, 1979
   K13 (a new strain) . . . . October, 1979

3. Number of batches reared:

   Number of batches reared ranged 20 to 80 by season and race.

RESULT AND CONCLUSION

The results obtained are shown in Tables 1 and 2.

There was found the same tendency that PECHMONT (1), CHOMCHUEN and CHAOSATTAKUL (2), TENGRATANAPRASERT, HARNKITCHANURUK, and NOI-SOMBAT (3), and CHAOSATTAKUL, HARNKITCHANURUK, and CHAOSATTAKUL (4) had shown clearly the varietal difference on the amount of mulberry leaves per batch in the older stage of each silkworm race, regardless of small differences in the younger stage.

From the data, it may be summarized that the amount of mulberry leaves per batch of silkworms required to their total larval stages is within the limits of 11.0 – 12.3 kg with the tendency to be the same as in the previous years.

LITERATURE

(1) PECHMONT, P.: Survey on the amount of food for the main silkworm races in the Centre. Bul. Thai Seri. Res. and Train, Centre, No. 5, 1975.
(2) CHOMCHUEN, V. and P. CHAOSATTAKUL: Ditto. Ibid. No. 6, 1976.
(3) TENGRATANAPRASERT, S., D. HARNKITCHANURUK and D. NOI-SOMBAT Ditto. Ibid. No. 7, 1977.
(4) CHAOSATTAKUL, P., D. HARNKITCHANURUK and D. CHAOSATTAKUL: Ditto. Ibid. No. 8, 1978.
(5) CHAOSATTAKUL, P., D. HARNKITCHANURUK and D. CHAOSATTAKUL: Ditto Ibid. No. 9, 1979.

Table 1. Amount of leaves supplied (1979)

Race		K1				K13
HAKITATE		January	June	August	October	October
Stage	Batches reared	40	80	68	20	80
1	Food/batch (g)	41.5	29.9	34.7	45.2	50.3
	Temp. ave. (°C)	27.5	29.2	29.4	26.9	27.6
	Hum. ave. (%)	64	71	73	67	67
2	Food/batch (g)	160.0	81.0	104.4	111.5	138.3
	Temp. ave. (°C)	28.1	28.8	25.5	27.0	26.6
	Hum. ave. (%)	62	75	72	64	71
3	Food/batch (g)	469.0	355.0	306.4	484.0	565.0
	Temp. ave. (°C)	27.3	29.0	29.9	26.3	24.4
	Hum. ave. (%)	64	80	69	71	73
4	Food/batch (kg)	2.2	1.7	1.7	1.9	2.2
	Temp. ave. (°C)	26.5	28.8	29.9	28.5	28.3
	Hum. ave. (%)	63	72	68	72	73
5	Food/batch (kg)	7.5	8.8	8.8	9.8	8.3
	Temp. ave. (°C)	27.1	28.5	29.0	26.3	27.6
	Hum. ave. (%)	61	71	75	70	73
Total	Food/batch (kg)	10.4	10.9	10.9	12.2	11.2
	Average (kg)	11.1				11.2
	Temp. ave. (°C)	27.3	28.9	28.7	27.0	26.9
	Hum. ave. (%)	63	74	71	70	71

Table 2. Amount of leaves supplied (1979)

	Race	K8				K18			
	HAKITATE	January	June	August	October	January	June	August	October
Stage	Batches reared	30	40	60	60	20	60	50	35
1	Food/batch (g) Temp. ave. (°C) Hum. ave. (%)	49.7 27.2 64	38.0 29.0 75	34.4 28.9 72	46.6 27.4 61	54.8 26.8 65	31.0 29.3 70	34.0 29.6 69	42 2 27.4 63
2	Food/batch (g) Temp. ave. (°C) Hum. ave. (%)	130.7 27.9 62	80.0 29.2 79	96.8 28.8 73	118.0 26.6 66	130.1 27.0 66	134.5 28.3 78	104 0 29.7 69	146.2 26.2 71
3	Food/batch (g) Temp. ave. (°C) Hum. ave. (%)	371.3 27.5 63	372.0 29.7 77	322.5 30.3 67	374.0 28.3 75	448.5 26.7 65	390.2 29.0 80	311.6 30.3 67	360.8 28.3 74
4	Food/batch (kg) Temp. ave. (°C) Hum. ave. (%)	2.3 26.5 63	1.9 28.0 76	1.8 28.8 79	1.9 27.4 73	2.0 27.0 62	1.8 28.8 72	1.3 29.9 69	1.4 27.0 73
5	Food/batch (kg) Temp. ave. (°C) Hum. ave. (%)	9.7 27.1 64	9.9 28.5 82	9.4 28.6 72	10.1 26.4 69	8.4 27.9 64	9.1 28.5 71	8.4 29.1 71	10.4 26.3 69
Total	Food/batch (kg)	12.6	12.2	11.7	12.5	11.0	11.4	10.1	12.3
	Average (kg)	12.3				11.2			
	Temp. ave. (°C) Hum. ave. (%)	27.2 63	28.9 78	29.1 72	27.2 69	27.1 64	28.8 74	29.7 69	27.1 70

31. The Effects of Hydrochlorization and Differently Refrigerated Terms on Hatchability of Silkworm Eggs Shortly after being Laid (4)

Peerapong CHAOSATTAKUL and Masashi RACHI

In the previous experiments (1), (2), (3), (4), and (5), we reported already the effects of the cold storing term on artificial hatching of silkworm eggs shortly after being laid. Then, the authors have reached a conclusion on the experiment (5) in the last year that the practical term of cold storing of silkworm eggs treated with HCl shortly after being laid is not more than 30 days.

Subsequently, this experiment was carried out repeatedly to reconfirm and to practise the HCl-treatment usable for artificial hatching of silkworm eggs shortly after being laid, adding the new hybrids, K1xK18, K13xK18 etc., bred in this Centre.

MATERIALS AND METHODS

1.	Time of experiment	:	17 September, 1979 – 11 January, 1980
2.	Variety of silkworm used	:	K1xK8, K8xK1, K1xK18, K13xK8, K13xK18, and K8xK13
3.	Date of eggs laid	:	17 September, 1979 and 21 November, 1979
4.	Number of eggs used	:	(4 batches x 4) x 10 = 160 batches
5.	Temperature of the room where the eggs had been kept before hydrochlorization	:	24 – 26°C.
6.	The time from oviposition to hydrochlorization	:	15 hours
7.	Temperature and specific gravity of HCl solution	:	35°C, and 1.10 at 35°C
8.	Duration of hydrochlorization	:	35 minutes
9.	Time of preservation of eggs in the room at 25°C after hydrochlorization	:	25 hours
10.	Temperature of cold storage	:	5°C
11.	Term of cold storing	:	0, 20, 30, and 40 days

RESULTS AND CONCLUSION

Results are shown in Tables 1 and 2.

From the results, in the cases of the new hybrids it may be concluded that the practical term of cold storing of silkworm eggs treated with HCl shortly after being laid is not more than 30 days in a similar way to the previous results.

LITERATURE

(1) HAYASHI, Y: Experiment on the method of artificial hatching of silkworm eggs to be practised in Thailand. Bul. Thai Seri. Res. and Train. Centre, No. 1, 1971.

(2) CHOMCHUEN, V.: Experiment to find the adequate time of cold storing of silkworm eggs treated with HC1 solution shortly after bing laid. Ibid. No. 3, 1973.

(3) CHOMCHUEN, V. and P. CHAOSATTAKUL: The effects of hydrochlorization and differently regrigerated term on hatchability of silkworm eggs shortly after being laid (1) Ibid. No. 6, 1976.

(4) CHOMCHUEN, V. and P. CHAOSATTAKUL: Ditto. (2), Ibid, No. 7, 1977.

(5) CHAOSATTAKUL, O. and M. RACHI: Ditto (3), Ibid. No. 9, 1979.

Table 1. Hatchability on artificial hatching of silkworm eggs shortly after being laid (September, 1979)

Variety	Term of cold storing (days)	Daily percentage of hatched eggs (%)						Unhatched eggs (%)
		1st	2nd	3rd	4th	Total	Successive highest two days	
K1xK18	0	89.1	3.9	0.6	–	93.6	93.0	6.4
	20	80.2	4.8	0.7	–	85.7	85.0	14.3
	30	87.1	8.6	0.4	–	96.1	95.7	3.8
	40	79.5	3.3	–	–	86.1	82.8	17.2
K13xK18	0	88.1	9.7	0.1	–	97.9	97.8	2.1
	20	81.3	9.7	1.4	–	92 4	91.0	7.6
	30	56.7	31.1	6.6	0.7	95.1	87.8	4.9
	40	81.1	8.7	0.4	–	90.2	89.8	9.9
K13xK8	0	92.4	5.8	–	–	98.2	98.2	1.8
	20	84.3	7.8	–	–	92.1	92.1	7.9
	30	38.8	53.8	2.6	0.2	95.4	92.6	4.6
	40	46.1	34.7	2.1	0.7	83.6	80.8	11.9
K8xK13	0	84.0	14.7	0.3	–	99.0	98.7	1.0
	20	72.2	15.6	0.8	–	88.6	87.8	11.4
	30	54.8	37.9	3.1	–	95.8	92.7	4.2
	40	72.3	16.7	0.6	–	90.6	90.0	10.4
K8xK1	0	88.2	8.1	–	–	96.3	96.3	3.7
	20	87.0	5.0	0.6	–	92.6	92.0	7.4
	30	74.0	18.0	0.9	–	92.9	92.0	7.0
	40	54.3	6.0	0.6	–	60.9	60.3	39.1

Table 2. Hatchability on artificial hatching of silkworm eggs shortly after being laid (November, 1979)

Variety	Term of cold storing (days)	Daily percentage of hatched eggs (%)						Unhatched eggs (%)
		1st	2nd	3rd	4th	Total	Successive highest two days	
K1xK8	0	59.8	31.7	2.0	0.3	93.8	91.5	6.2
	20	90.8	2.8	0.9	–	94.5	93.6	5.5
	30	90.3	1.8	0.1	–	92.2	92.1	7.8
	40	52.9	12.3	4.8	1.3	71.3	65.2	28.7
K8xK1	0	41.7	50.2	0.5	0.2	92.6	91.9	7.4
	20	84.2	4.2	0.4	–	88.8	88 4	11.2
	30	87.0	1.6	0.1	–	88.7	88.6	11.3
	40	47.0	9.0	2.0	0.2	58.2	56.0	41.8
K1xK18	0	65.6	30.6	0.9	–	97.1	96.2	2.9
	20	92.1	1.3	0.4	–	93.8	93.4	6.2
	30	87.6	4.0	–	–	91.6	91.6	8.4
	40	56.6	6.3	1.9	–	64.8	62.9	35.2
K13xK18	0	44.2	49.8	2.9	0.1	97.0	94.0	3.0
	20	81.1	5.9	1.5	–	88.5	87.0	11.5
	30	91.3	3.2	0.2	–	94.7	94.5	5.3
	40	53.7	20.1	6.8	2.3	82.9	73.8	17.1
K13xK18	0	76.1	21.9	0.4	0.1	98.5	98.0	1.5
	20	93.8	3.1	1.0	–	97.9	96.9	22.1
	30	91.8	3.0	0.1	–	94.9	94.8	5.1
	40	71.5	6.3	2.5	1.2	81.5	77.8	18.5

32. Effects of Different Cold Storing Terms of Silkworm Eggs on Their Hatchabilities in the Acid-Treatment after Chilling Method (3)

Peerapong CHAOSATTAKUL and Masashi RACHI

The previous experiments (1), (2), (3), (4) are summarized as follows, though the varieties and the condition of acid-treatment were different from those described later. 1) The time of cold storage at 5°C: 50 – 80 days. 2) In case of 40 days' cold storing of the silkworm eggs, no good hatching was ever seen. 3) The eggs cold-stored for more than 30 days showed good hatching in the case of 50 minutes or more soaking in s.g.1.13 HC1. 4) Eggs cold-stored for 120 days showed good hatching in all cases. 5) Eggs cold-stored at 5°C for 40 – 80 days produced a good hatching ratio. 6) Refrigerated for 100 days or more, the hatchability of the silkworm eggs went down. 7) Eggs cold-stored at 5°C for 50 – 70 days produced considerable hatching ratios.

Accordingly, the present experiment was performed to confirm the effects of the different refrigerating terms of silkworm eggs on their hatchabilities in the standard acid treatment after chilling, especially putting stress on the cases of short or long cold stored duration (40 or 100 days), using one of the most available silkworm varieties and some new hybrids for their practical process of sericulture in the tropics.

MATERIALS AND METHODS

1.	Time of experiment	:	25 Feb., 1979 – 9 Jan., 1980
2.	Variety of silkworm	:	K1xK8, K8xK1, K1xK18, K18xK1, K13xK8, K8xK13, and K13xK18
3.	Date of eggs laid	:	25 Feb., 1979 and 19 Sept., 1979
4.	Temperature of room where eggs had been kept before cold storing	:	24 – 26°C
5.	Duration of storage in the above room	:	45 hours
6.	Temperature of cold storing	:	5°C
7.	Term of cold storing	:	40, 60, 80, and 100 days
8.	Number of eggs used	:	(4 batches x 9) x (3+4) = 252 batches
9.	Temperature and specific gravity of HC1 solution	:	35°C, and 1.110 at 35°C
10.	Duration of hydrochlorization	:	40 minutes

RESULTS AND CONCLUSION

The results obtained are shown in Tables 1 and 2, and summarized in the following.

Eggs cold-stored at 5°C for 40 – 100 days produced available hatching ratios in the cases of new hybrids (K13xK18, K13xK8 and their reciprocals, K18xK13, K8xK13) as well as K1xK8 or K8xK1.

Needless to say, ti is one of the most important matters to set the adequate storing pericd usable for the artificial hatching of cold-stored silkworm eggs. The results mentioned above seem to be promising for the sericultural practices. The detailed evaluation tests will be required in the next season.

LITERATURE

(1) HAYASHI, Y.: Experiment on the method of artificial hatching of silkworm eggs to be practised in Thailand. Bul. Thai Seri. Res. and Train. Center, No. 1, 1971.

(2) HAYASHI, Y. and V. CHOMCHUEN: Experiment on the method of artificial hatching of silkworm eggs by HC1 solution after cold storage. Ibid. No. 2, 1972.

(3) BUACHOOM, K. and S. TENGRATANAPRASERT: Effects of the different cold storing term of silkworm eggs on their hatchabilities in the acid-treatment after chilling method (1). Bul. Thai Seri. Res. and Train. Centre, No. 6, 1976.

(4) CHAOSATTAKUL, P. and M. RACHI: Ditto. (2), Ibid. No. 9, 1979

Table 1. Hatchability of cold-stored silkworm eggs (February, 1979)

Variety	Term of cold storing (days)	Daily percentage of hatched eggs (%)						Unhatched eggs (%)
		1st	2nd	3rd	4th	Total	Successive highest two days	
K1xK18	60	81.5	4.1	0.5	–	86.1	85.6	13.9
	80	5.7	64.7	22.6	–	93.0	87.3	7.0
	100	50.8	39.9	2.8	–	93.5	90.7	6.5
K18xK1	60	96.5	1.6	–	–	98.1	98.1	1.9
	80	39.1	56.9	1.2	–	97.3	96.0	2.7
	100	88.8	9.6	0.5	–	98.9	98.4	1.1
K1xK8	60	88.1	2.0	0.3	0.2	90 6	90.1	9.4
	80	49.7	39.6	1.7	–	91.1	89.3	8.9
	100	66.0	23.6	1.2	–	90.8	89.6	9.2
K8xK1	60	85.9	11.1	0.2	–	97.2	97.0	2.8
	80	24.1	63.8	7.9	–	95.8	89.7	4.2
	100	54.5	37.8	1.4	–	93.7	92.3	6.3

Table 2. Hatchability of cold stored silkworm eggs (September, 1979)

Variety	Term of cold storing (days)	Daily percentage of hatched eggs (%)						Unhatched eggs (%)
		1st	2nd	3rd	4th	Total	Successive highest two days	
K8xK13	40	49.3	34.1	10.0	–	93.4	83.4	6.6
	60	20.5	56.7	20.0	1.2	98.4	77.2	1.6
	80	40.7	55.6	1.9	–	98.2	96.3	1.8
	100	28.8	63.5	1.7	0.8	94.8	92.3	5.2
K13xK8	40	50.2	40.4	6.5	–	97.1	90.6	2.9
	60	38.5	49.1	7.6	1.7	96.9	87.6	3.1
	80	87.8	8.8	0.5	–	97.1	96.6	2.9
	100	34.4	60.7	1.8	0.4	97.3	95.1	2.7
K1xK18	40	35.6	55.2	6.4	–	97.2	90.8	2.8
	60	44.1	49.6	3.8	–	97.5	93.7	2.5
	80	36.2	59.3	2.4	–	97.9	95.5	2.1
	100	18.1	70.6	8.6	–	97.4	88 8	2.6
K8xK1	40	70.4	25.8	2.3	–	98.5	96.2	1.5
	60	28.3	65.1	5.1	0.2	98.7	93.4	1.3
	80	66.0	32.2	1.1	–	99.2	98.2	0.8
	100	22.4	72.7	2.5	0.2	97.8	95.1	2.2
K13xK18	40	38.8	55.0	3.3	–	97.1	93.8	2.9
	60	29.8	44.1	23.9	0.5	98.3	73.9	1.7
	80	63.9	33.7	0.7	–	98.3	97.6	1.7
	100	23.8	70.8	1.4	0.1	96.1	94.6	3.9

33. Effects of Temperature Keeping Male Moths before Mating on Production of Non-Fertilized Eggs (2)

Masashi RACHI, Phuchong PECHMONT, Banjob HARNTHONGCHAI*, and Pichit POCHAUM*

To raise the efficiency of silkworm egg production, it is one of the most important matter to make the most of normal silkworm eggs by decreasing impractical eggs, for example, non-fertilized eggs, dead eggs and so on.

For the purpose to materialize this problem, this experiment was repeatedly performed to investigate effects of male moths kept in natural temperature or in cold storage at 7°C before their mating on production of non-fertilized eggs.

MATERIALS AND METHODS

1. Time of experiment : June 1979
2. Race of silkworm : I1 (♂) and K18 (♀)
3. Date and station of eggs depositon : June, 1979 and Udorn Thani Sericultural Experiment station
4. Male moths to be tested were divided into two groups of A and B as follows:

   A) Male moths kept in natural temperature (26° – 33°C)
   B) Male moths preserved in cold storage at 7°C

   Moreover, both of A and B had the same two mating times as mentioned below:

   1) 09:00 – 12:00
   2) 13:00 – 16:00

5. Number of moths used:

   K1 (♂): 100 x 2 = 200
   K18 (♀): (100x2) x 2 = 400
   Total : 600 heads

6. Treatments

   (1) Collected until 08:00 a.m., 100 male moths each were placed into moth collection box each. Then, A group and B group were kept in rearing room (26°C – 33°C) and in cold storage at 7°C, respectively.

   (2) Transferred to 4 rearing trays with 100 heads per tray until 09:00 a.m., 400 female moths to be crossed were grouped into two lots with two trays.

   (3) Both A and B group had two mating times a day. And in B group, after the respective separation the male moths were preserved into cold storage at 7°C.

(4) Number of eggs laid, classified into normal eggs, non-fertilized eggs, dead eggs and so on, were counted after 48 hours from the end of egg deposition.

* Udorn Thani Sericultural Experiment Station

RESULTS AND CONCLUSION

Shown in Table 1, the results are summarized as follows:

1. As for the silkworm eggs produced by the first mating, there was no marked difference between A and B group on the completion of normal, non-fertilized, and dead eggs, respectively.

2. However, in cases of the silkworm eggs produced by the second mating, there were clear differences between the group of A and B.

   1) Number of normal eggs in A group decreased more than 10% as compared with B group.

   2) Non-fertilized eggs of A group increased more than 16% as compared with B group.

From the above results it must be concluded on the treatment of male moths that available male moths to be crossed should be carefully and timely cold-stored at 7°C for their possible utility values.

LITERATURE

(1) RACHI, M., P. PECHMONT, B. HARNTHONGCHAI and P. POCHAUM: Effects of temperature keeping male moths before mating on production of non-fertilized eggs. Bul. Thai Seri. Res. and Train. Centre, No. 9. 1979.

Table 1. Ratio of non-fertilized eggs, produced by mating male moths preserved at 7°C or natural temp.

Order of mating time	Card no.	Eggs of A-group Normal (%)	Non-fertilized (%)	dead (%)	Total	Eggs of B-group Normal (%)	Non-fertilized (%)	dead (%)	Total
1 09:00–12:00	1	76.78	20.30	2.92	100	88.91	8.73	2.36	100
	2	91.52	6.37	2.11	100	92.56	7.11	0.33	100
	3	78.70	19.26	2.04	100	80.39	18.36	1.25	100
	4	83.35	15.64	1.01	100	90.57	8.68	0.75	100
	av.	82.59	15.39	2.02	100	88.11	10.72	1.17	100
2 13:00–16:00	1	78.61	18.58	2.81	100	66.08	31.17	2.75	100
	2	49.04	47.18	3.78	100	83.37	16.08	0.55	100
	3	55.64	38.49	5.87	100	79.65	18.70	1.65	100
	4	45.24	53.68	1.08	100	47.52	24.80	27.68	100
	av.	57.13	39.48	3.39	100	69.16	22.69	8.15	100

34. Formulation of the Standard Table of Parent Silkworm Rearing in the Grown Stage

Masashi RACHI, Peerapong CHAOSATTAKUL,
Phuchong PECHMONT, and Kanung BUACHOOM

In order to produce abundantly the better silkworm eggs of hybrids, their parent silkworm rearing should be rationally managed.

For the purpose, using the several existing silkworm races, bred in the Centre, the surveys on their growing process and the amount of mulberry leaves supplied to them have been performed at every rearing season since 1974 (1).

As a result, it was concluded that there might be in the same tendency among the parent races at grown stages (4th – 5th instar) during the seasons from June to October, on the abovementioned items of rearing practices.

And, a practical standard of rearing process of parent silkworms is shown in Table 1.

LITERATURE

(1) RACHI, M., P. PECHMONT and Kanung BUACHOOM: Formulation of the standard table of parent silkworm rearing in the young stage. Bul. Thai Seri. Res. and Train. Centre, No. 8. 1978

Table 1. The standard table of parent silkworms (10 batches) rearing in the old stage for the seasons, in June, August and October (23 – 32°C)

Stage	Order of day		Feeding time	Amount of leaves (kg)	Remarks
	from HAKITATE	from IV stage			
IV	13	1	06:00 11:00 16:00	0.8 0.8 1.4	1. After all get up, disinfection of silkworms and net setting before feeding. 2. Bed cleaning and rearing bed, enlarged a little. 3. Number of silkworms should be counted to have 400 heads in a rearing tray.
	14	2	06:00 11:00 16:00	1.2 1.2 2.0	Spacing before feeding.
	15	3	06:00 11:00 16:00	1.6 1.8 2.8	Spacing and disinfection of silkworms, and net setting before feeding.
	16	4	06:00 11:00 16:00	2.2 2.6 2.6	Bed cleaning Spacing rearing bed before feeding.
	17	5	06:00 11:00 16:00	2.0 – –	Cut leaves into small pieces. Be in dry condition
	18	6	06:00 11:00 16:00	– – 1.6	After all get up, disinfection of silkworms and net setting before feeding.
V	19	7	06:00 11:00 16:00	1.8 2.2 3.2	Bed cleaning
	20	8	06:00 11:00 16.00	2.8 3.2 4.8	Spacing and disinfection of silkworms and net setting before feeding.
	21	9	06:00 11:00 16:00	4.6 5.0 7.8	Bed cleaning Spacing and disinfection of silkworms and net setting before feeding.

Stage	Order of day		Feeding time	Amount of leaves (kg)	Remarks
	from HAKITATE	from IV stage			
V	22	10	06:00 11:00 16:00	6.4 6.8 10.6	Bed cleaning Spacing and disinfection of silkworms and net setting before feeding
	23	11	06:00 11:00 16:00	7.6 7.6 11.0	Bed cleaning Spacing and disinfection of silkworms and net setting before feeding.
	24	12	06:00 11:00 16:00	6.0 5.0 5.0	Bed cleaning, pick up matured larvae to mount.
	25	13	06.00 11:00 16:00	3.0 - -	Pick up matured larvae to mount.

Total amount of food: IV stage = 23.0 kg.
V stage = 106.0
Total = 129.0

35. Experiments on Effects of the Time from Egg Laying to Acid-Treatment on the Hatchability in the Artificial Hatching of Silkworm Eggs

Phuchong PECHMONT, Yasuhisa MANO, Iwao YAMAMOTO,
and Hisao SUMITA

The right time for conducting acid treatment is about the 20th hour after oviposition, preserved at 24 – 25°C (1).

Generally, moths emerged from cocoons in the morning are allowed to copulate for 3 – 4 hours, and separated around noon. Many of moths lay eggs until the following morning, but we calculate the time after oviposition from 7 or 8 p.m.

The 20th hour after oviposition roughly falls on 3 p.m. of the following day. So, we conduct the acid treatment around this hour.

When the acid treatment is to be postponed, eggs are preserved at 25°C for 20 hours after oviposition, and then cold-stored at 5°C. The period of cold storage is to be within a week. At any time during the cold storage, we can take eggs out of the refrigerator and conduct the acid treatment, but before the treatment the eggs must be exposed to 25°C for 2 – 4 hours. If they are dipped in the hydrochloric acid immediately after taking out of refrigerator, the sudden change in temperature does harm in handling them.

The development of embryo varies with temperature kept during oviposition and after being laid. Consequently, it is safe to adjust the time of acid treatment.

These experiments were conducted to study the right time for confirming the common acid treatment, related to the artificial hatching method in Thailand (2), (3), (4), and (5).

Additionally, the experiments were carried out at the KWANSAI BRANCH, The National Sericultural Experiment Station, M.A.F.F., Japan, where PECHMONT P. stayed to study the silkworm egg production courses for three month, October to December, 1979.

MATERIAL AND METHOD

Materials and methods are summarized in Table 1.

RESULT AND CONCLUSION

The results obtained are shown in Table 2.

Treated by hydrochrolic acid at around the 20th hour after oviposition under the two given experimental conditions, (1) to preserve the silkworm eggs at 25°C from oviposition to acid-treatment and (2) to use the hydrochrolic acid of 1.10 in the specific gravity at 15°C, the silkworm eggs had a tendency to be good in the hatchabilities.

In the meanwhile, the current method of acid-treatment in Thailand, located in the tropics, have been standardized as follows: (I) the silkworm eggs to be treated should be preserved at 28°C from oviposition to acid-treatment and (2) the hydrochrolic acid of 1.10 in the specific gravity at 35°C is useful for the treatment. And, under natural condition at higher temperature it has been recognized that the acid-treatment at the 15th hour after oviposition resulted in better hatchabilities of silkworm eggs.

It may be noted that common acid-treatment in the tropics should be carefully done under the said conditions.

LITERATURE

(1) Hand Book of Silkworm Rearing. Fuji Pub. Co., Ltd., Tokyo, 1972.

(2) RACHI, M.: The effect of environmental temperature in pupal stage on the hatching percentage of silkworm eggs hydrochlorized. Bul. Thai Seri, Res and Train. Centre, No. 5, 1975.

(3) CHOMCHUEN, V. and P. CHAOSATTAKUL: A test on the effect of temperature of HC1 solution on artificial hatching of silkworm eggs shortly after being laid (3). Ibid No. 6, 1976.

(4) CHOMCHUEN, V., P. CHAOSATTAKUL and D. HARNKITCHANURUK: Ditto. Ibid. No. 7, 1977.

(5) BUACHOOM, K., D, HARNKITCHANURUK, P. CHAOSATTAKUL, P. PECHMONT, K. SORNCHIT, D. CHAOSATTAKUL and S. TENGRATANAPRASERT: Experiment on the time from egg deposition to acid treatment an artificial hatching (SOKUSIN). Bul. Thai Seri. Res. and Train. Centre No. 9. 1979.

Table 1. Materials and Methods

Experiment	Date of exp.	Silkworm variety	No. of eggs used	Temp. & hum. (the eggs were kept before hydrochlorization)	The time from being laid to hydrochlorization	S.G. and temp. of HC1	Duration of dipping the eggs in HC1	Term of survey
I	13–13, Oct., 1979	CS14 (Chinese race)	5 batches with 5 rep. of a batch per treatment	25°C, 75%	14, 16, 18, 20 and 22 hours	1.10 (at 15°C) 26°C	65 minutes	Hatchability
II	do	do	do	do	do	1.10 (at 15°C) 35°C	35	do
III	12–30, Oct., 1979	N136 (Japanese race)	do	do	do	do	do	do
IV	11–3–Oct. 1979	N134 x C135 (F_1 hybrid)	5 batches with 4 rep. of a batch per treatment	do	do	do	do	do

Table 2. Hatchability of eggs

Treatment	Hatchability (%)			
	I	II	III	IV
14 hours after oviposition	96.9	67.6	94.5	80.2
16 hours after oviposition	98.9	66.5	93.6	81.3
18 hours after oviposition	99.0	66.8	89.0	96.0*
20 hours after oviposition	97.5	71.8	94.8	95.1*
22 hours after oviposition	97.7	83.3*	96.6	97.1*
Mean	98.1	71.5	93.8	91.3
Number of observation	25	25	25	20
C.V. (%)	5.9	8.1	6.7	10.8
F test	*significant at 5% level.			

36. Effect of Formalin Disinfection on Spore Population and Disease Occurrence of Aspergillus in a Cooperative Rearing House of Young Silkworms (2) Wet Season

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

One of the purposes of a cooperative rearing for young silkworms is to supply farmers with healthy and uniform silkworms at the 2nd or 3rd sleep, by taking more careful and concentrated control over the young stage silkworms susceptible highly to many kind of pathogens. Thus, control of diseases at the house will give good effects on the cocoon yields by every farmer to whom the young silkworms will be delivered at that rearing season. *Aspergillus* diseases, especially, have the biggest influence on the achievement of rearing at the house.

Following the previous paper (4), a series of investigation was made on the population and its seasonal fluctuation of *Aspergillus*, effects of disinfection on the population, actual occurrence of the disease, and the existence of *Aspergillus* or other pathogens in dust samples at a cooperative rearing house of young silkworms in wet season, 1979.

MATERIALS AND METHODS

Locality surveyed	:	Pimai self-help land settlement, Pimai, Korat
Time of survey	:	July rearing season (HAKITATE, July 7, 1979; 40 boxes of imported eggs) August-September season (HAKITATE, August 31, 1979; 29 boxes of imported eggs)
Disinfection	:	Prior to the starting of each rearing, the 1st disinfection with 3% formalin solution, washing and cleaning in order, and the 2nd disinfection with formalin solution. July rearing; the 1st disinfection, June 21; the 2nd disinfection June 26. August-September rearing season; the 1st disinfection, August 2; the 2nd disinfection, August 13.

The body surface disinfection was made once an instar by using Thai pafsol. The descriptions on the floor area, structure of the rearing house, and so on were shown in the previous paper (5).

Spore trapping	:	The trapping of *Aspergillus* spores was made on the following dates. July rearing season: June 19 (before disinfection), June 22 (after the 1st disinfection), June 27 (after the 2nd disinfection), July 3 (after the 2nd disinfection), and July 13 (the 2nd instar) August-September rearing season: July 18 (before disinfection), August 9 (after the 1st disinfection), September 1 (the 2nd day of the 1st instar), September 5 (the beginning of the 3rd instar), September 7 (the 3rd instar), and September 17 (after rearing)

Other methods or materials, if necessary, will be shown in each of items related to.

RESULTS

1. Trapping of *Aspergillus* spores in the air.

A method of trapping *Aspergillus* spores by using a filter paper and Rose Bengal agar (2) has been already reported (1), (3) and its slight modification, using a round filter paper of 9 cm in diameter, was shown in the previous paper (4).

For trapping of spores in each rearing season, four, three, fifteen and two petridishes at every exposure time, each containing a sheet of sterilized filter paper, were suitably put in the mulberry room, chopping room, rearing room, and dark room, before exposure for one, three, and five hours, respectively. Trapping was made eleven times, and the results are shown in Figs. 1 – 2 except that on June 27 to avoid a duplication after the 2nd disinfection.

In July rearing season, the population of *Aspergillus* spores trapped was considerably high in every room before disinfection, but it decreased remarkably after disinfections and became extremely small. However, at the 2nd instar, the population increased again, revealing that the rearing room was most polluted with *Aspergillus.*

In August – September rearing season, the mulberry room was most polluted before disinfection, but the population was generally decreased by the 1st disinfection, as in the other rooms.

Though no trapping was done after the 2nd disinfection of September 13, it was estimated that the population was more decreased thereafter. And there was a certain long period between the 2nd disinfection and the day of HAKITATE. With the starting of silkworm rearing, the population, also, began to increase highly again and remained at a high level in the every room throughout rearing duration. Generally, the chopping room and rearing room seemed to be most polluted. On the other hand, the population decreased in every room after rearing.

2. Inspections on silkworms infected with *Aspergillus* disease and on the population of spores in feces and litters on rearing beds.

The results are shown in Table 1.

For the inspection of silkworms infected with *Aspergillus* disease, about 400 to 1,000 larvae were suitably collected from some rearing trays at the house. A swarm of these larvae were separatedly put on Rose Bengal agar media after body surface sterlization with 70% alcohol (4) in the laboratory. After incubated for three days at 30°C, larvae which produced the mycelia of *Aspergillus* were referred to as "infected".

The infection rate of the specimen larva was remarkably high, compared with the rate in dry season last year (4). Especially, the rate attained 5.2% at the 2nd instar in July rearing season. In August – September rearing season, the rate ranged 1.4 to 4.7%, with the highest in the larvae at the end of 3rd instar.

Additionally, the infection rate of larvae without body surface disinfection could not be investigated, as appropriate silkworms as materials had not been obtained.

For the inspection on the population of *Aspergillus* spore on rearing beds, ten samples of feces and litters from each of ten rearing trays selected at random were collected (4).

The result showed that a high density of *Aspergillus* spores inhabited always in feces and litters of rearing beds. The spores detected were more abundant in number than those in the dry season (4). The population in feces and litters did not show a definite increasing tendency with the advancement of rearing. This tendency seemed to be much influenced by the cleaning of rearing beds or body surface disinfection.

3. Disease occurrence of the silkworms fed on mulberry leaves smeared with dust samples from the rearing sites and detection of *Aspergillus* spores in the dust samples.

The results of feeding test (5) are shown in Tables 2 – 5.

The kind of diseased silkworms which appeared after feeding tests of dust samples collected from four sites at the house was highly limited to *Aspergillus* and flacherie with the highly descreased rates. None of nuclear polyhedrosis, cytoplasmic polyhedrosis- and muscardines- infected silkworms appeared. The disease rates were generally lower than those obtained in dry season last year. In case of *Aspergillus*, the rate of occurrence had a slightly increasing tendency before disinfection and after rearing.

On the other hand, media tests revealed that dust samples collected from each of sites in the cooperative rearing house had frequently a fair number of *Aspergillus* spores, with the same decreasing tendency after disinfection and the rapidly increasing tendency after starting of the rearing. The inspection on August 30 showed a high density of the spores even in one day before HAKITATE. There appeared to be the frequent cases in which we could not count the number of colony on the media, since the spores developed collectively due to high concentration in suspensions. In such cases, the number of colony was shown as >100. In future, a serial dilution of spore suspensions will be requested in order to make it possible to calculate the number of spores more exactly.

DISCUSSION

Following the previous study (4) which had been done in dry season last year, this investigation was made to get information in wet season. However, owing to some difficulties in acquisition of sufficient materials of the silkworm and information on rearing status, the results obtained were somewhat restricted to be compared with those last year.

The spores trapped in the air of the house showed much higher population in both rearing seasons, especially in August – September rearing season, compared with dry season. There is not a good reason that the spore population seemed to be very different between two rearing seasons in a year; partly because climatic conditions might be different, partly because the workings of disinfection might be insufficient as seen in a long period between the 2nd disinfection and HAKITATE.

Thus, one of the problems of formalin disinfection, so far as *Aspergillus* is concerned, was pointed out as follows. the population decreased effectively in number after the disinfection, recovering to higher level immediately after the starting of silkworm rearing and remaining at the same level during the rearing. This fact seemed to be mainly caused by the relations to working activities by the persons taking care of silkworms and to the appropriate temperature and humidity provided for fungus growth with starting of rearing.

These results would demonstrate clearly that the body surface disinfections subsequent to formalin disinfections are indispensable for rearing silkworms.

The infection rate of the specimen larvae from the house was remarkably high in every case as compared with the previous results, showing the extremely low rate even in the worms without body surface disinfection in the dry season last year. Though the number of samples taken from the rearing trays were considerably small, it was doubtful to say that the samples could reflect faithfully the whole status of silkworm rearing at the house. However, the results which amounted to the rate of 1.4 to 5.2% in the four cases of investigations should not be neglected. Because, the incidence of silkworm diseases at younger stages at the house would cause not only the reduction of amount of worms to be delivered, but also give inevitably the bad crop of cocoons as infection sources after delivery to individual farmhouses. In addition, *Aspergillus* spores were detected at a high rate in feces and litters on rearing beds. This would largely contribute to the high incidence of the disease in young silkworms.

Moreover, in July rearing season, the silkworms were without predetermination delivered to individual farmhouses at the second sleep because of shortage of mulberry leaves in their joint field and resulted in less amount of cocoons of 9 kg per box on the average. The possible biggest reason of these bad crops seemed to be in the high incidence of the uncocooning worms after mounting in common with every farm, though there had happened a lot of undergrown worms from their early stages of silkworms soon after delivered to each farm. In August - September rearing season, a lot of uncocooning worms appeared again and resulted in less cocoon yields.

The further studies would be broadly required for the clarification of causes for high incidence of uncocooning silkworms in farmhouses and its possible association with silkworm rearing under the cooperative rearing system, as the outbreaking of the disease would be caused by the interaction with many complicated factors.

On the other hand, the feeding of dust samples from the applicable sites of the house resulted in only a small rate of occurrence of the disease. This was extremely smaller than in the dry season last year. So we might say that so far as other pathogens were concerned, they were effectively eliminated by formalin disinfections.

Nevertheless, *Aspergillus* spores were highly enduable in dust samples even after disinfection, and soon recovered to the high level with starting of rearing. This might be due partly to depend on their ability to be able to run saprophytic living. Moreover, *Aspergillus* disease occurred slightly in the worms fed on dust samples, but it may be said that the rate would not reflect properly the high population of the spores in the results of media tests. This was due supposedly to the fact that the feeding test was a method to catch pathogens of oral infection unlike *Aspergillus.*

The results obtained in this paper might suggest that further improvement of disinfection in wet season was necessary for a cooperative rearing house. And, also, the effective population of *Aspergillus* fungus to cause outbreak of the disease and distribution of its tolerant strain to formalin should be clarified at a cooperative rearing house, making an analysis on other disease factors, in the future.

SUMMARY

The *Aspergillus* spores trapped in the air of the cooperative rearing house showed much higher population in both rearing seasons of July and August – September, especially in the latter, compared with dry season. The population decreased effectively in number after formalin disinfections, but it rebounded to high level as the rearing started, remaining at higher level throughout rearing duration.

The *Aspergillus* infection rate of the specimen larvae from the house was remarkably high, compared with that of dry season, attaining 1.4 to 5.2%. Accordingly, the spores were detected at a high rate in feces and litters on rearing beds.

The feeding of dust samples from the house resulted in only a small rate of occurrence of the disease, so other different pathogens from *Aspergillus* might be effectively eliminated by formalin disinfections. In addition, *Aspergillus* spores were highly enduable in dust samples.

The results might suggest that the body surface disinfections subsequent to formalin disinfections are indispensable, and that further improvement of disinfections in wet season would be necessary in a cooperative rearing house.

LITERATURE

(1) ISARANGKUL, L. *et al.*: An inspection of *Aspergillus* in the Sericultural Centre and farmhouse. Bul. Thai Seri. Res. and Train. Centre, No. 3, 1973.

(2) KAWAKAMI, K.: On the selective medium of *Aspergillus* fungi. Acta Soricologia. (64) (In Japanese), 1967.

(3) SINCHAISRI, N. *et al.*: A method of trapping *Aspergillus* spores. Bul. Thai Seri. Res. and Train. Centre, No. 3, 1973.

(4) ISARANGKUL, L. *et al.*: Effect of formalin disinfection on spore population and disease occurrence of *Aspergillus* in a cooperative rearing house of young silkworms. (1) Dry season. Ibid. No. 9, 1979.

(5) ISHIJIMA, T., *et al.*: 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 silkworm and farmhouses (1). Ibid No. 9, 1979.

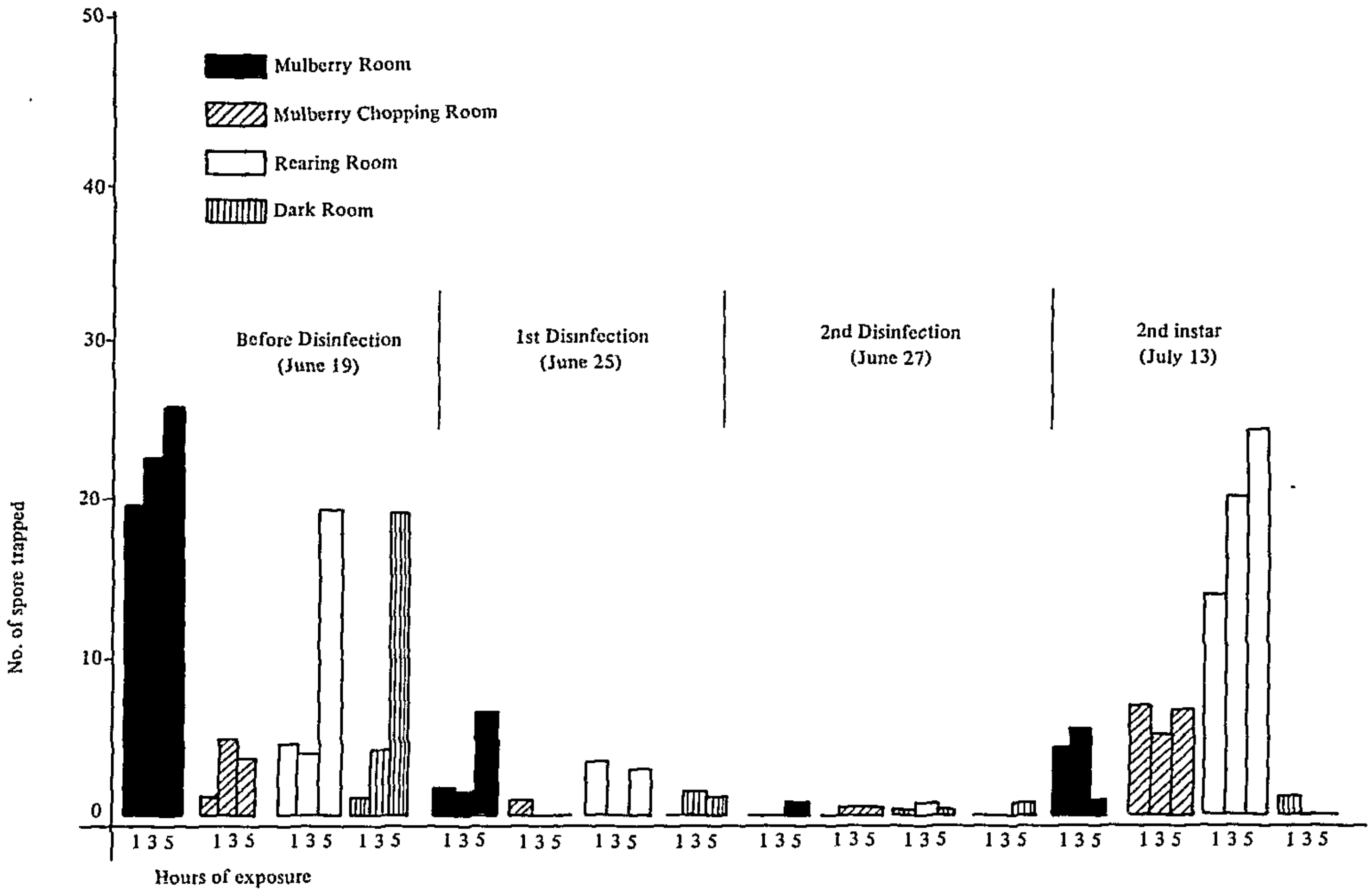

Fig. 1. The population of *Aspergillus* spores in a cooperative rearing house (July rearing season, 1979)

Remark The dates in parenthesis show the dates of trapping

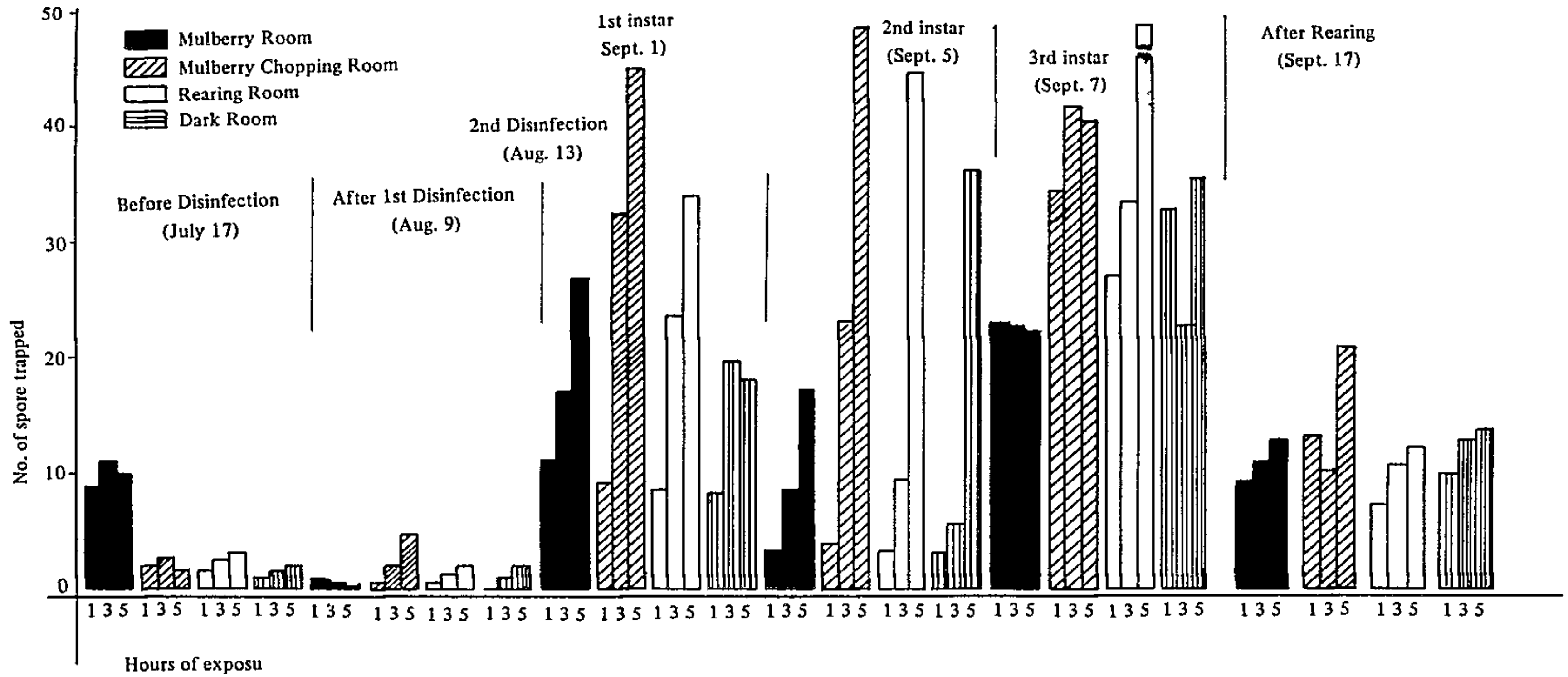

Fig. 2 The population of *Aspergillus* spores in a cooperative reairng house of young silkworms (August – September rearing season 1979)

Table 1. Infection of young silkworms with *Aspergillus* and detection of the spores in feces and litters of rearing beds at a cooperative rearing house of young silkworms (1979)

Season of rearing	Date of collection	Stage of tested	No. of tested	No. of infected (%)	No. of colony 1) of *Asp.* in feces and litters. Range (average)
July HAKITATE, July 8	July 13	2	979	51 (5.2)	0 – 43.5 (14.5)
August – September	Sept. 1	1	445	14 (3.2)	1 – 104 (51.1)
	Sept. 5	2	420	6 (1.4)	0 – 192 (20.7)
HAKITATE, August 31	Sept. 7	3	450	21 (4.7)	1 – 50.5 (9.1)

1) Ten samples, each having two petridishes, from different rearing trays, were tested for the number of colony to be counted. The number of colony was shown on the average.

Table 2. Disease occurrence of the silkworms fed on mulberry leaves smeared with dust samples from a cooperative rearing house and detection of *Aspetgillus* spores in the samples (1) Mulberry room.

Date of collection	Working state		Rate of disease (%) 1) 2)					No. of colony 3) of *Aspergillus* in dust sample
	Rearing	Disinfection	As	N	C	F	Total	
June 19	Before	Before	1	0	0	0	1	>100
June 25	"	After 1st	4	0	0	0	4	27.5
June 27	"	After 2nd	0	0	0	0	0	>100
July 3	"	After 2nd	0	0	0	0	0	0
July 13	2nd instar	–	0	0	0	1	1	146.5
July 17	After	–	0	0	0	1	1	114 5
Aug. 9	Before	After 1st	0	0	0	0	0	2.5
Aug. 30	"	After 2nd	2	0	0	2	4	>100
Sept. 1	1st instar	–	0	0	0	1	1	16
Sept. 5	2nd sleep	–	1	0	0	1	2	45.5
Sept. 7	3rd instar	–	0	0	0	0	0	>100
Sept. 17	After	–	0	0	0	0	0	>100

Remarks:

1) The rates are shown in average of two replications of 50 larvae.
2) The abbreviations are shown as follows: As; *Aspergillus* disease, N, Nuclear polyhedrosis disease, C; Cytoplasmic polyhedrosis disease, F; Flacherie disease.
3) The number of colony is shown in average of two petri-dishes

Table 3. (2) Chopping room of mulberry leaves

Date of collection	Working state		Rate of disease (%)					No. of colony of *Aspergillus* in dust sample
	Rearing	Disinfection	As	N	C	F	Total	
June 19	Before	Before	6	0	0	0	6	>100
June 25	"	After 1st	1	0	0	1	2	105.5
June 27	"	After 2nd	2	0	0	1	3	50
July 3	"	After 2nd	0	0	0	0	0	5
July 13	2nd instar	–	0	0	0	0	0	–
July 17	After	–	3	0	0	0	3	>100
Aug. 9	Before	After 1st	0	0	0	0	0	10
Aug. 30	"	After 2nd	0	0	0	2	2	82
Sept. 1	1st instar	–	1	0	0	3	4	>100
Sept. 5	2nd sleep	–	1	0	0	4	5	>100
Sept. 7	3rd instar	–	0	0	0	0	0	>100
Sept. 17	After	–	1	0	0	1	2	>100

Remarks: See Table 2.

Table 4. (3) Rearing Room

Date of collection	Working state		Rate of disease (%)					No. of colony of *Aspergillus* in dust sample
	Rearing	Disinfection	As	N	C	F	Total	
June 19	Before	Before	12	0	0	0	12	>100
June 25	"	After 1st	0	0	0	0	0	1.5
June 27	"	After 2nd	0	0	0	0	0	17.5
July 3	"	After 2nd	0	0	0	0	0	97 5
July 13	2nd instar	–	0	0	0	0	0	>100
July 17	After	–	1	0	0	0	1	153.5
Aug. 9	Before	After 1st	0	0	0	0	0	10
Aug. 30	"	After 2nd	0	0	0	0	0	>100
Sept. 1	1st instar	–	5	0	0	0	5	>100
Sept. 5	2nd sleep	–	0	0	0	0	0	>100
Sept. 7	3rd instar	–	0	0	0	0	0	>100
Sept. 17	After	–	0	0	0	0	0	>100

Remarks: See Table 2.

Table 5. (4) Dark Room

Date of collection	Working state		Rate of disease (%)					No. of colony of *Aspergillus* in dust sample
	Rearing	Disinfection	As	N	C	F	Total	
June 19	Before	Before	4	0	0	1	5	70
June 25	"	After 1st	0	0	0	0	0	6
June 27	"	After 2nd	0	0	0	0	0	-
July 3	"	After 2nd	0	0	0	0	0	–
July 13	2nd instar	–	0	0	0	0	0	>100
July 17	After	–	30	0	0	2	32	–
Aug. 9	Before	After 1st	0	0	0	0	0	63.5
Aug. 30	"	After 2nd	0	0	0	0	0	–
Sept. 1	1st instar	–	0	0	0	0	0	–
Sept. 5	2nd sleep	–	3	0	0	0	3	–
Sept. 7	3rd instar	–	7	0	0	1	8	–
Sept. 17	After	–	13	0	0	0	13	>100

Remarks: See Table 2.