BULLETIN
OF THE
THAI SERICULTURAL
RESEARCH AND TRAINING CENTRE
NO. 9
AUGUST 1979

THE THAI SERICULTURAL RESEARCH AND TRAINING CENTRE
KORAT, THAILAND

Japan International Cooperation Agency, Tokyo, Japan

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PREFACE

This report contains the results of surveys and researches pursued in the Centre in 1978, including the Mukdaharn Station, under the guidance of our experts concerned. And, the contents of them were released and discussed in the annual research meeting in the International YMCA, Chieng Mai, on 19–20, March, 1979.

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

Additionally, our technical cooperation in the first year of the follow-up term from April, 1978 to March, 1980, following the past 9 years' cooperative duration (1969–1978), mainly took active parts in the fields undermentioned.

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, 1979

JAPAN INTERNATIONAL COOPERATION AGENCY

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1. Effect of Stock of Pai Variety on the Growth of Four different Mulberry Varieties (3)

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 higher resisting power to root rot disease than the others, 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).

MATERIAL AND METHOD

Experimental design	:	Latin Square method, 4 treatments (varieties), 4 replications.
Varieties	:	1. Noi 2. Soi 3. Tark 4. Keaw Chonabod
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 and 2. The results showed that there were non-significant differences of yields and number of shoots except for the length of shoot. Though the length of shoot of Noi was shorter than the other three varieties, the high yield may result in shorter inter-nodes and thicker leaves. The experiment is to be continued in the succeeding years.

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.

Table 1. Analysis of variance of yields, length and number of shoots

SV	d.f.	Yield (kg/rai)		Yield (kg/tree)		Number of shoot		Length of shoot (cm)	
Total	47	M.S.	F.	M.S.	F.	M.S.	F.	M.S.	F.
Row	3	401,109.08	(1.06) ns	0.0590	(<1)	2.3611	(<1)	217.7222	(<1)
Col.	3	534,389.74	(1.44) ns	0.3911	(1.24) ns	0.1389	(<1)	1,608.3889	(2.92) ns
Treatment	3	50,048.35	(<1)	0.0381	(<1)	3.5833	(<1)	4,260.6667	(7.38)*
Error (a)	6	372,019.95		0.3142		4.2778		577.3333	
Time	2	1,983,429.77	(14.52)**	2.3975	(140.99)**	42.5833	(34.84)**	16,002.0625	(161 63)**
Time x treatment	6	57,423.44	(4.20)**	0.0871	(5.12)**	7.2500	(5.93)**	136.7292	(1.38) ns
Error (b)	24	13,664.04		0 0170		1.2222		99.0069	
CV. (a) %		55.0		39.4		14.3		13 6	
CV. (b)%		10.5		9.2		7.6		5.6	

Table 2. Table of means

Treatment	Yield (kg/rai)					Number of shoot				Length of shoot			
	Harvesting					Harvesting				Harvesting			
	1	2	3	Total	Ave.	1	2	3	Ave.	1	2	3	Ave.
Tark	1,423 → a	1,215 b	498 c	3,136	1,045	14 a → b	17 a ↓ a	13 b ↓ b	15	217	174	152	181 a
Keaw Chonabod	1,236 → a	1,168 a	824 b	3,228	1,076	12 a → b	15 a a	16 a a	14	226	180	174	193 a
Soi	1,451 → a	1,198 b	712 c	3,361	1,120	13 a → b	16 a a	13 b b	14	218	164	164	182 a
Noi	1,390 → a	1,387 a	806 b	3,971	1,194	13 a → b	16 a a	16 a a	15	190	129	130	150 b
Average	1,375	1,242	710			13	16	15		213 (a)	162 (b)	155 (b)	

2. Mulberry Variety Trial on Pai Variety Root-Stocks (2)

Nimit MUTTAMARA

Now in Thailand, mulberry root rot disease is the most important to be protected. And no researcher has found how to keep off suitably the disease by any chemical or cultivation methods. The mulberry varieties which are encouraged sericultural farmers to distribute are Noi, Tadam etc. Though these varieties have high crop 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 resisting 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 cuttings inserted directly in the same infected field (1).

MATERIAL AND METHOD

Form of experiment	:	Latin Square method, 3 treatments (varieties), 3 replications.
Varieties	:	1. Noi (Bud-grafting)
		2. Tadam (Bud-grafting)
		3. Pai (Direct cutting)
Area of a plot	:	11.25m x 10.00 m
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, yield of leaves, number of shoots and length of shoots were not statistically significant among treatments. The results showed that Noi and Tadam with bud-grafting did not come in effect to have higher yield than direct cutting of Pai variety. This restult in the first year was not satisfactory, followed by outbreak of root rot disease in the field, as shown in larger coefficient of variability (68%) with the yield.

The experiment is to be continued.

LITERATURE

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

Table 1. Analysis of variance of yields, length, and number of shoots

SV	d.f.	Yield (kg/rai)		Yield (kg/tree)		Number of shoot		Length of shoot (cm)	
Total	26	M.S.	F.	M.S.	F.	M.S.	F.	M.S.	F.
Row	2	378,990.70	(<1)	0.4336	(<1)	1.8148	(<1)	40.7037	(<1)
Col.	2	108,496.15	(<1)	0.1000	(<1)	13.4815	(2.41) ns	298.9259	(<1)
Treatment	2	488,021.59	(<1)	0.6573	(<1)	63.2593	(11.31) ns	4,970.7039	(8.47) ns
Error (a)	2	611,352.26		0.7492		5.5926		586.7037	
Time	2	354,342.70	(504)*	0 2941	(3.19) ns	57.8148	(12.80)**	60,186.9291	(369.12)**
Time x treatment	4	68,271.54	(<1)	0.1406	(1 52)	11.5370	(2.55) ns	536.5370	(3.29)*
Error (b)	12	70,356.42		0.0922		4.5185		163.0556	
C.V. (a) %		68.5		61.5		14.2		13.2	
C.V. (b) %		23.2		21.6		12.8		7.0	

Table 2. Table of means

Treatment	Yield (kg/rai)					Number of shoot				Length (cm)			
	Harvesting					Harvesting				Harvesting			
	1	2	3	Total Yield	Ave.	1	2	3	Ave.	1	2	3	Ave.
1. Pai (stock) + Noi (scion)	997	843	844	2,684	895	17	18	11	15	130 a → b	96 b↓	254 b↓	160
2. Pai (stock) + Tadam (scion)	1,406	1,144	971	3,521	1,174	15	15	14	15	160 a → b	127 ab	263 b	183
3 Pai (direct cutting)	1,575	1,518	980	4,073	1,357	19	24	16	20	160 a → b	148 a b	314 a a	207
Average	1,326	1,168	932			17 b	19 a	14 c		150	124	277	

3. Comparison of Mulberry Yield between 3 times Harvesting and 4 Times Harvesting a Year for Silkworm Rearing (1)

Manoch PANYAWANICH and Nimit MUTTAMARA

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

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 Blocks design, 5 treatments, replications.
2. Varieties : Noi (scion), grafted May 1977 into Pai (stock), planted by cuttings in June, 1978.
3. Area of a plot : 10.50 x 10.0 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)

8. Items of survey

(1) Amount of whole lot and leaf 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 experimental trees are growing and 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. (3) Ibid. No. 8, 1978.

4. Comparison of Yields of Mulberry Trees Planted with Different Distance of Inter-Row and Inter-Tree (1)

Jaras CHINCHIEM and Nimit MUTTAMARA

Planting distance and number of trees per unit area have close relations with training method, maintenance by hand or machine, yields 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).

MATERIAL AND METHOD

1. Experimental design : 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, 30 kg x 10 bags = 300 kg (compound fertilizer: N-15%, P_2O_5-8%, K_2O-10%)
8. Time of training and harvesting:

   March : Base cut
   June : Middle cut
   September : Shoot cut
   December : Shoot cut

RESULT

The experimental trees are growing 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.

5. Effect of Foliage Spray of Nitrogen Fertilizer on Mulberry Leaves for Young Silkworm

Nimit MUTTAMARA and Bhinai HONGTHONGDAENG

The growth of mulberry are changeable by season. Accordingly, in dry season, mulberry leaves for young silkworms will be prepared earlier by cutting mulberry about 45 days before the planned date of Hakitate.

This experiment was carried out to know the effect of foliage spray of nitrogen fertilizer on mulbery leaves for young silkworms after cutting.

MATERIAL AND METHOD

Urea, dissolved 200 grams in water of 20 ℓ per 1 row of mulberry field (30 trees, Soi variety) at 6.00 a.m. of the respective 0, 7, 14 and 21 days before the date of Hakitate in October, 1978. The experiment was repeated in January, 1979

RESULTS

The highest yield of leaves in October was shown in the plot sprayed 14 days before Hakitate, followed by control (Table 1). And the highest yield of leaves in January was obtained in "7 days plot", followed by control (Table 2).

Table 1. Number of shoots, length of branches, and yield of leaves in October 1978

Date, sprayed before Hakitate	No. of shoots	Length of branch (cm)	Yield (kg/30 trees)	Yield (kg/rai)
0 day	25.7	69.2	5.20	147.85
7 days	29.9	67.8	4.60	130.79
14 days	30.3	67.2	5.50	156.38
21 days	37.0	60.5	4.20	119.42

Remarks: 1. 1st spraying: 24th, September, 1978
2. Harvesting : 16th, October, 1978

Table 2. Number of shoots, length of branches, and yield of leaves in January 1979

Date, sprayed before Hakitate	No. of shoots	Length of branch (cm)	Yield (kg/30 trees)	Yield (kg/rai)
0 day	30.2	59.0	3.87	110 03
7 days	32 7	55 6	3.96	112.60
14 days	31.3	54.2	3.30	93 69
21 days	30.7	57.7	3.80	107.90

Remarks: 1. 1st spraying: 24th, December, 1978
2. Harvesting : 15th, January, 1979

6. Study on the Germination Method of Mulberry Seeds (A Preliminary Note)

Bhinai HONGTHONGDAENG

The germinating ability of mulberry seeds is dependable upon temperature, humidity, light, age, storage conditions etc. In this experiment, the author tried to germinate under some different conditions.

MATERIAL AND METHOD

The seeds of Pai variety harvested late in November 1978 were used for their germination test on 8th, January, 1979.

For the experiment, there were 3 treatments, and 2 replications with each 100 seeds per treatment.

1st treatment: seeds were put on a wet filter paper at the bottom in petri dish, 19 cm in diametre.

2nd treatment: seeds were put on wet sand at the bottom of petri dish, 19 cm in diametre.

3rd treatment: seeds were put in sand sprayed by water 2 times a day.

RESULT

The highest percentage of germination (95.0 – 94.5%) was shown in the first and second treatment, because the temperature and humidity (Table 1) might be optinum for their germination.

Table 1. Results of germination test

Treatment	Germination (%)	Germinating time (day)	Temp average (°C)	Height of young (°C) stem (cm)	Length of young stem root (cm)
1	95.0	3.7	28.5	1.31	1.96
2	94.5	3.7	28.8	1.46	0.43
3	32.0	10.2	22.9	1.07	0.66

Remarks. 1) Length of longest primary root was surveyed on the 10th day and 18th day after germination in the 1st and 2nd treatment, and 3rd treatment, respectively.

7. An Experiment on Planting Density of Mulberry Tree (4)

Jaras CHINCHIEM and Bhinai HONGTHONGDAENG

Recently, in Thailand the training method of cutting shoots at the base once a year has been applicable to all the mulberry field, properly manured and maintained. However, experiments for planting density of mulberry trees are scarecely carried out. The aim of the experiment is to know some effects of the different planting space on vitality and yield of mulberry trees, and to find out the proper number of mulberry trees to applying to practice for the sericultural farmers in the tropics.

The experiment was started since 1975.

MATERIALS AND METHODS

1. Variety : Noi (Sapling by cutting, March 1975)
2. Time of planting : July, 1975
3. Training : Low-cutting, Ken-type
4. Area tested : 1 rai
5. Plots (one plot consisted of 3 ridges with 2 replications)

Item / Plot	Inter-ridge distance	Inter-tree distance	No. of trees/rai	Remarks
A	2.5m	0.75m	852	Usual in the Centre
B	2.5	0.50	1,280	
C	2 5	0.30	2,133	
D	2.5	0.50 x 0.50	2,560	"Yose-une" planting

6. Planting method

Removing old trees for replanting, we cultivated all over the field being in the above-mentioned inter-ridge and inter-tree distance by using the bottom plow. Every planting trench was digged 50 cm in depth and 60 cm in width. Composts and chemicals were put into it and covered with soils. Then, saplings were planted.

7. Manuring : 3,200 kg. of compost was given in March; chemical fertilizer N-48 kg, P_2O_5-24 kg, and K_2O-32 kg, were put in March, July, and October, divided in three equal parts.
8. Harvest

1st year : Not harvested

2nd year : Base cutting and harvesting were postponed, caused by the bad current growth of mulberry.

From the third year on :

March	:	Base cut
June	:	Shoot thinning
September	:	Middle cut at the height in 1 m from the base.
November	:	Shoot cutting, leaving a shoot on each old shoot.
January	:	Cutting the shoot left as it was in November.

9. Items for investigation

No. of plants : 20x2 ridges, total 40

Total harvested amount and leaf yield.

Growth survey : No. of shoots and the total length of the shoots of every plant at the harvesting time.

Vitality : No. of normal, weakened, and dead plants at the harvesting time.

RESULT

Results are shown in Tables 1-3.

Unfortunately, the experiment will be finished next year because of frequent occurrence of damaged trees. The results of this year's survey are summarized as follows:

(1) From Table 1, the shoots in all plots showed approximately same in number except for plot B-rep. 1 with more shoots than the others.

(2) Plot-D (Yose-une type) showed longer shoot in length and higher yield in amount of leaves.

LITERATURE

(1) CHINCHIEM, J. and Y. YANO: An experiment on planting density of mulberry trees. Bul. Thai Seri. Res. and Train. Centre, No. 6, 1976.
(2) CHINCHIEM, J. and Y. YANO: Ditto. Ibid. No. 7, 1977.
(3) CHINCHIEM, J. and B. HONGTHONGDAENG: Ditto. Ibid. No. 8, 1978.

Table 1. Number of shoots

Plot	Rep. I				Ave.	Rep. II				Ave.
	Jan. 1978	Sept.	Nov.	June 1979		June 1978	Sept.	Nov.	Jan. 1979	
A	–	–	–	–	–	7	7	12	6	8
B	10	8	16	8	11	7	6	12	5	8
C	7	7	12	5	8	–	–	–	–	–
D	6	6	10	4	7	6	7	10	4	7

Table 2. Length of shoot (cm)

Plot	Rep. I				Ave.	Rep. II				Ave.
	June 1978	Sept.	Nov	Jan. 1979		June 1978	Sept.	Nov.	Jan. 1979	
A	–	–	–	–	–	96	147	103	132	120
B	102	147	120	132	125	87	133	140	121	111
C	108	141	110	133	123	–	–	–	–	–
D	109	161	108	158	134	104	158	113	116	123

Table 3. Yield of leave (kg/rai)

Plot	Rep. I				Total	Rep. II				Total
	June 1978	Sept.	Nov.	Jan 1979		June 1978	Sept.	Nov.	Jan. 1979	
A	–	–	–	–	–	38	111	175	44	368
B	63	350	297	62	772	94	208	191	68	561
C	98	254	372	103	827	–	–	–	–	–
D	163	421	297	268	1,149	117	345	343	54	859

8. Experiment on the Method of Harvesting Shoots for for 3 Rearing Seasons (4)

Manoch PANYAWANICH and Jaras CHINCHIEM

In the Centre, mulberry shoots for silkworm rearing are hither to harvested 4 times a year with the same tree by thinning out at the base, combined with middle cut. The tree under this harvesting method loses sometimes its vitality earlier.

This experiment was started in 1976 to know how to harvest mulberry shoots suitable for silkworm rearing 3 times a year.

MATERIALS AND METHODS

1. Mulberry variety : Noi
2. Date of planting : June, 1976
3. Type of training : "Ken-type", NEGARI (low-cut)
4. Planting space : Inter-row distance, 2.5 m.
   Inter-tree distance, 0.75 m.
5. Area tested : 0.56 rai
6. Number of trees planted per plot : 27 x 2 rep. = 54
7. Harvesting time

   On and after 2nd year : Harvested as follows:

Item / Plot	Before harvest		Method of harvesting					
	March	April	June	July	Sept.	Oct.	Dec.	Jan.
I	B.C.	–	B.T.	–	B.M.	–	S.C.	–
II	B.C.	S.A.	B.M.	–	S.C.	–	(S.C.)	–
III	B.C.	S.A.	–	B.M.	–	S.C.	–	(S.C.)

Note: B.C. Base cut

B.T. About 1/3 of shoots, including dwarf and drooping ones, are thined out at the base.

B.M. Middle cut, shoots are pruned about 1 m (plot 1 and 3) and 0.7 m (plot 2), respectively, in height from the base.

S.C. Regenerated shootlets after middle cut are pruned, remaining a few leaves at their base.

(S.C.) Young shoots, occurring after S.C. treatment, are harvested, remaining a few leaves at their base.

S.A. Many current young shoots (about 3 cm in length) growing after base-cut are arranged by thinning, remaining 15 – 16 well grown ones.

8. Number of trees surveyed.

20 tress; 2 rows with 10 trees per plot.

9. Items of survey.

(1) Amount of whole lot and leaf 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.

10. Nanuring.

N-48kg, P_2O_5-24kg, K_2O-32kg, Compost-3,200kg per rai, per year. Applied total composts in March, and chemicals by one-third in March, July, and October, respectively.

RESULT

From Table 1, Plot II and Plot III, both having no shoot harvested by thinning method, totalled higher crop than Plot I with the same results as in last year. It may be said that thinning method is not so good for silkworm rearing.

LITERATURE

(1) YANO, Y. and K. YAMAKAWA: Experiment on the method of harvesting shoot for 3 rearing seasons (1) A preliminary experiment. Bul. Thai Seri. Res. and Train. Centre, No. 7, 1977.
(2) PANYAWANICH, M. and J. CHINCHIEM: Ditto. (2), Obid. No. 7, 1977.
(3) PANYAWANICH, M. and J. CHINCHIEM: Ditto. (3), Ibid. No. 8, 1978.

Table 1. Yield of leaves (kg)

Plot	June 1978	July "	Sept. "	Oct "	Dec. "	Jan. 1979	Total	Yields 1977
I	Thinning 149		Middle cut 247		Middle cut 351		747	993
II	Middle cut 171		Shoot cut 283		Shoot cut 396		850	1,675
III		Middle cut 84		Shoot cut 606		Shoot cut 262	952	1,369
Total	320	84	530	606	747	262	2,549	4,042

Table 2. Number and length of shoot

Plot	Item	June 1978	July "	Sept. "	Oct. "	Dec. "	Jan 1979	Total	Ave.
I	No. of shoot	9	–	7	–	12	–	28	9
	Length of shoot (cm)	161	–	230	–	150	–	541	180
II	No. of shoot	9	–	14	–	11	–	34	11
	Length of shoot (cm)	128	–	74	–	147	–	349	116
III	No. of shoot	–	8	–	12	–	12	32	11
	Length of shoot (cm)	–	136	–	135	–	96	367	122

9. An Experiment on Planting of Mulberry Saplings Grafted by Resistant Variety to Root-Rot Disease in its Infected Field (2)

Manoch PANYAWANICH

We have on the whole established the grafting method to protect mulberry trees from root-rot damage (1), (2), (3), (4). This experiment was carried out to know the occurrence of root-rot damaged trees and the growth of mulberry trees under their infected field condition, using the different types of saplings to be raised.

MATERIALS AND METHODS

1. Grafting method and saplings planted: Saplings used were raised by the following method: Using Pai, a resistant variety to root-rot disease as stock in length of about 40 cm, and Noi, a sensitive variety to the disease, as scion, the respective grafting saplings by veneer grafting, bark grafting, cleft grafting, and bud grafting were inserted in the nursery after storing them in the wetted saw dust for some seven days (1), (2), (3), (4). Besides, the cuttings, Noi and Pai, were prepared.

2. Planting time : 10 August, 1977

3. Planting distance : Inter-row 2.5 m, inter-tree 0.75 m.

4. Maintenance and manuring : as usual in the Centre

5. Area tested : 1 rai

6. Training : Low-cut with fist

7. Plot tested: The above mentioned saplings by the grafting and two kinds of cuttings, Pai and Noi varieties, were planted as shown in the previous report (1). Area tested was divided into two blocks, A block with two replications, consisting of each 25 trees, B block with five replications, consisting of each 10 trees.

8. Harvesting method:

In the second year (1978) of planting

June	:	Base cut
November	:	Middle cutting
Next February	:	Recurrent shoots cutting

9. Check on trees damaged by root-rot. Every damaged tree was monthly observed after about two month and recorded in the register according to their symptoms, healthy (–), slight (+), not-serious (++), serious (+++) and dead (0). No missing tree will be replenished during the test period.

10. Notes:

(1) Every grafting sapling was planted to keep the scion at about 20 cm high from the ground level because of keeping a scion from its rooting.

(2) About two months after planting the tied string was removed and the recurrent shoots on the stock were taken off.

RESULT

This year's results left something to be desired because of frequent occurrence of mulberry root-rot disease, as shown in Tables 1 and 2, recording 7.4% of Pai variety and 98.7% of Noi in Plot A, and 24.4% of Pai and 100% of Noi in Plot B with the respective damage percentages.

In addition, each grafting sapling (Pai as a stock, Noi as a scion) resulted in less damage percentages than that of Noi cutting.

LITERATURE

(1) YAMAKAWA, K.: A test on the grafting of mulberry tree. Bul. Thai Seri. Res. and Train. Centre No. 4, 1974.
(2) YAMAKAWA, K.: Ditto (2). Ibid. No. 5, 1975.
(3) YANO, Y. and J. CHINCHIEM: A supplementary test on the grafting of mulberry tree. Ibid. No. 6, 1976.
(4) YAMAKAWA, K. and M., PANYAWANICH: An experiment on plating of mulberry saplings grafted by resistant variety to root-rot disease in its infected field. Ditto. No. 8, 1978.

Table 1. Number of tree damaged by root-rot

Plot A

Variety	No. of tree	Not servived	Survived	Diseased (root-rot)	Percentage of damage
Pai cutting	156	8	148	11	7.4
Noi cutting	104	24	80	79	98.7
Veneer grafting	104	9	95	34	35.8
Cleft grafting	104	10	94	30	31.9
Bud grafting	104	6	98	43	43.9

Table 2. Number of tree damaged by root-rot

Plot B

Variety	No. of tree	Nor survived	Survived	Diseased (root-rot)	percentage of damage
Pai cutting	50	9	41	10	24.4
Noi cutting	50	6	44	44	100.0
Veneer grafting	50	6	44	12	27.3
Cleft grafting	50	3	47	18	38.3
Bud grafting	50	7	43	13	30.2

10. The Amount of Mulberry Leaves Produced in the Centre from June 1978 to February 1979

Manoch PANYAWANICH

The amount of mulberry leaves produced in the Centre for rearing silkworm from June 1978 to February 1979 is shown in Table 1. 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 1,574 kg. Yield of leaves for old silkworm were 4,707 kg., and 11,899 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, the yield of leaves amounted almost to the previous year's (1), though there were 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.8. 1971 – 1978.

Table 1. Seasonal yield of mulberry (kg)

Rearing season	For young silkworm (1st - 3rd stage)		For old silkworm (4th and 5th stage)		
	Harvesting method	Yield of leaf	Harvesting method	Yield of leaf	
June 1978	leaf picking	262	middle cutting	4,707	
August 1978	leaf picking	478	shoot cutting	3,052	Total 11,899
October 1978	leaf picking	474	shoot cutting	5,222	
January 1979	leaf picking	360	shoot cutting	3,625	
Total		1,574		16,606	

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

Rearing season	(1st – 3rd stage)		(4th – 5th stage)	
	Harvesting method	Yield of kg/rai	Harvesting method	Yield, kg/rai
June 1978	leaf picking	174	middle cutting	472
August 1978	leaf picking	276	shoot cutting	356
October 1978	leaf picking	136	shoot cutting	372
January 1979	leaf picking	112	shoot cutting	427

Note: Amount of leaves per rai for old silkworm is estimated to weigh about 1,500 kg a year.

Table 3. Yealy yield of leaves consumed for the total silkworms (kg)

1973		1974		1975		1976		1977		1978	
Yield of leaf		Yield of leaf		Yield of leaf		Yield of leaf		Yield of leaf		Yield of leaf	
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
1,958	18,710	1,864	20,008	2,269	18,442	2,121	19,558	1,567	16,352	1,574	16,606
20,668		21,872		20,711		21,679		17,919		18,180	

11. *Meteorological Record in the Centre in 1978*

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 be shown here.

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

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

1. Air temperature (Table 1)

The daily lowest temperature recorded was 12.2°C on 22th, 23th January, while the highest was 40.0°C on 8th, 9th, 11th, 12th March, 21th, 22nd April and 1st May. The lowest temperature in the 10 days of each month occurred in the last 10 days of January.

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

2. Rainfall (Table 1)

The total annual rainfall in the Centre was 748.5 mm. The highest monthly rainfall, 251.0 mm, was found in September and the lowest 10.7 mm was in April, while no rain in January and December.

The whole amount of rainfall in this year was lower than those of last year (930 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 siklworms.

3. Evaporation

Evaporation was recorded for the whole year, showing the highest in March (9.1 mm/day) and the lowest in September (4.5 mm/day).

Table 1. Temperature (°C) rainfall and evaporated water

Month		Air temperature °C			Rain-fall (mm)	Evaporated water (mm/day)		
		Average	Highest	Lowest		Average	Max.	Min.
January	1	22.5	27.6 (34.0)	17.1 (13.1)		6.0	7.3	4.8
	2	23.7	30.6 (33.8)	18.3 (15.0)		6.1	6.9	5.1
	3	23.4	31.3 (36.6)	17.5 (12.2)		6.1	6.9	5.2
Average or sum		23.2	29.8 (36.6)	17.6 (12 2)		6.0	7.3	4.8
February	1	25.8	31.8 (34.0)	20.6 (14.0)		5.9	7.2	2.8
	2	27.4	32.6 (36.6)	22 7 (18.5)	15.7	7.1	8.5	5.9
	3	26.6	30.5 (34.0)	22 4 (21.2)	2.2	4.9	7.7	2.7
Average or sum		26.6	31 6 (36.6)	21.9 (18.5)	17.9	6.1	8.5	2.7
March	1	30.3	38.3 (40.0)	23.7 (21.1)		9.3	11.7	8.1
	2	31.2	38.3 (40.0)	25.3 (21.6)	27.4	9.1	11.0	7.0
	3	31.6	38.3 (39.3)	26.2 (23.1)	38.4	8.8	10.6	6.9
Average or sum		31.0	38.3 (40 0)	25 0 (21.1)	65.8	9.1	11.7	6.9
April	1	32.4	38.7 (40.0)	26.8 (24.7)		8.6	9.5	8.0
	2	30.4	36.0 (39.0)	25 8 (25.1)	10.7	7.8	9.9	5.1
	3	31 9	37.6 (40.0)	27.3 (25 6)		9.7	11.8	7.8
Average or sum		31.6	37 4 (40.0)	26.6 (24 7)	10.7	8.7	11.8	5.1
May	1	31.3	36.8 (40.0)	27.4 (25.1)	17.0	7.6	9.8	4.7
	2	29.6	34.2 (36.3)	26.8 (25.6)	146.0	5.7	7.8	3.2
	3	31.2	36.3 (38.0)	29.7 (27.1)	6.3	8.5	10.3	5.1
Average or sum		30.7	35 8 (40.0)	27.4 (25.1)	169.3	7.0	10.3	3.2
June	1	31.8	37.8 (39.9)	27.9 (27.3)		8.3	9.0	7.9
	2	30.7	35.2 (38.3)	27.1 (26.7)	4.4	6.2	9.3	3.0
	3	30.9	35.6 (37.0)	27 3 (26.4)	7.5	7.4	8.4	5.0
Average or sum		31.2	36 3 (39.9)	27.5 (26.4)	11.9	7.3	9.3	3 0
July	1	28.9	32.4 (34.0)	26.9 (26.0)	32.6	3.7	4.4	2.8
	2	30.2	34.5 (36.0)	26.9 (25.5)	24.1	6.2	8.9	2.5
	3	30.9	34.7 (36.2)	27.7 (26.0)	19.3	6.4	8.7	3.7
Average or sum		30.1	33.9 (36.2)	27.2 (25 5)	76.0	5.2	8.9	2.5
August	1	32.2	35.2 (37.0)	28.3 (27.6)	8.1	63	8.7	4.7
	2	29.4	32.9 (35.7)	27.1 (26.0)	53.1	4.9	7.9	1.2
	3	31.1	35.1 (36.5)	27.7 (25.9)	0 5	6.5	8.8	4.8
Average or sum		30.6	33.1 (37.0)	27.7 (25 9)	61.7	5.9	8.8	1.2

Month	Air temperature (°C)			Rain-fall (mm)	Evaporated water (mm/day)		
	Average	Highest	Lowest		Average	Max	Min
September 1	30.7	34.9 (37.3)	27.4 (26.5)	65.7	5.9	8.2	4.1
2	29 3	32.6 (34.8)	27.2 (26.3)	62.5	3.3	6.3	1.7
3	29.2	32 3 (34.7)	26 8 (26.0)	122 7	4.3	7.8	0.7
Average or sum	29.8	33.3 (34.8)	27.2 (26.0)	250 9	4.5	8.2	0.7
October 1	29.9	32.8 (35.0)	27.7 (27.0)	28.0	5.1	7.1	0.8
2	28.9	33.4 (36.6)	25.2 (22.0)		5.9	6.9	4.8
3	28.1	31.6 (34.0)	24.9 (19.7)	32.1	5.0	7.1	2.6
Average or sum	28.9	32 6 (36 6)	35.9 (19.7)	60.1	5.4	7.1	0.8
November 1	26.9	30.8 (32.7)	23.4 (19.0)	24.0	5.1	7.1	2.6
2	27.9	32.3 (33.2)	23.3 (20.0)		5.6	6.2	4.8
3	26.6	32.8 (38.0)	21.4 (20 0)		6.0	8.0	2.8
Average or sum	27.2	31.9 (38.0)	22.7 (19.0)	24.0	5.6	8.0	2.6
December 1	27.1	32.3 (34 0)	22 4 (19.1)		6.3	7.8	5.1
2	24.8	30.6 (31.7)	19.5 (17.3)		6.2	7.0	5.6
3	29.1	32.8 (35.3)	20.5 (19.5)		6.4	7.5	6.0
Average or sum	26.2	31.9 (35.3)	20.8 (17.3)		6.3	7.8	5.1

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

12. Effect of Manuring on the Growth of Mulberry

Sombat MANEECHOTE and Niramitr KLANGPHAPAN
(The Mukduharn Seriultural Experiment Station)

The foundation of sericulture lies in the growing of mulberry. It is well recognized that mulberry grows fully and wears large, and thick leaves by suitably manuring for sericulture to be conducted according to the plan.

The object of this experiment is to know the regional effect of manuring on the growth of mulberry in cooperation with the Stations [1].

MATERIAL AND METHOD

1. Time of planting : 6th July, 1977

2. Variety : Noi by cutting directly in the field.

3. Distance of planting : Inter-row, 2.50 m and inter-tree, 0.75 m.

4. Area tested : About 2 rais consist of the following 5 plots with each two replications of 0.20 rai per plot, including border area between one and another plot.

5. Plot

Treatment	Compost	N	P_2O_5	K_2O
1	3,000	48	24	30
2	3,000	32	16	20
3	3,000	16	8	10
4	3,000	–	–	–
5	–	–	–	–

6. Manuring

First year : Compost; annual amount is put in each ditch before planting. Chemical fertilizer; half of annual amount is spread on the soil surface at the both sides of the tree planted and the remainder is applied on the ground in August and October, divided into two equal parts, respectively.

After second year : Compost; applied in the shallow ditch dug on a side of each row, in April. Chemical fertilizer; one third of annual amount is applied in April, July, and October, respectively.

Non-manured : Before and after planting, both chemical and compost are not applied.

7. Training : Low cut, 30 cm high from the base.

8. Harvesting : First year: Not harvested

After second year:

April : Base-cut.

August : Midle-cut at 1 m in height from the base.

October : Regenerated young shoots after August are cut at 3 – 5 cm high from their base.

February : Regenerated young shoots after October are cut at 3 – 5 cm high from their base.

9. Items to be measured or observed.

1. Healthiness of trees: The respective number of healthy, weakened, root-rotted and dead trees are recorded at every harvesting time.

2. Yield of leaves:

(1) The total yield of leaves on the healthy trees are calculated as follows.

Weight of shoots x percentage of leaves.

(2) Percentage of leaves on the harvested shoots are calculated on the basis of

$$\frac{\text{weight of leaves}}{\text{weight of shoots}} \times 100$$

About 1 – 5 kg of shoots on the middle row are harvested.

(3) Growth of trees to be measured on 40 trees in the middle row.

1) Number of shoot per tree.
2) Length of the longest shoot on each tree.

RESULT

Number and length of shoots in the more manuring treatment showed better than the less and non-manured.

Yield of leaves per rai in treatment 2 was the highest with four times the amounts of the non-manured, 1949 and 476 kg/rai, respectively.

Vitality of stumps in the non-manured, as shown in the Table 3, were poor and seemed to be resulted in increasing weakened and dead trees. And it may be said that this harvesting method was not applicable to poor mulberry trees in growth.

From data as shown in Table 2, higher productivity in treatment 2 than treatment 1 may be caused by over-supplied fertilizer in treatment 1 or unevenness of soil fertility between them. The experiment is to be continued for several years.

Table 1. Number and length of shoot (cm)

Treatment	Aug. 1978		Oct. 1978		Feb. 1979	
	Number	Length	Number	Length	Number	Length
1	5	239	16	171	25	92
2	5	246	18	126	22	97
3	4	250	16	121	24	67
4	5	255	14	107	19	49
5	5	231	10	76	11	38

Table 2. Yield of leaves (kg/rai)

Treatment	Aug. 1978	Oct. 1978	Feb. 1979	Total	Index
1	685	800	311	1,796	377
2	775	833	341	1,949	409
3	703	751	187	1,641	344
4	510	353	132	995	209
5	264	140	72	476	100

Table 3. Vitality of stumps

Treatment	August 1978			October 1978			February 1979			Remarks
	H	W	D	H	W	D	H	W	D	
1	271	–	41	271	–	41	266	1	45	H: Healthy
2	272	1	39	267	1	44	253	5	54	W: Weakened
3	270	–	42	269	–	43	265	4	43	D: Dead
4	286	–	26	286	–	26	282	2	28	
5	295	3	14	295	3	14	270	14	28	Root-rotted, 12 stumps

LITERATURE

1. YAMAKAWA, K.: Effect of manuring on the growth of mulberry. Bul. Thai Seri. Res. and Train. Centre. No. 8. 1978.

13. Experiment on Planting Density of Mulberry Trees in Mukdaharn Station

Sombat MANEECHOTE, Niramitr KLANGPHAPAN and Narachai SITIKARN
(The Mukdaharn Sericultural Experiment Station)

The most popular distance of mulberry planting in Thailand is inter-row 2.50 m and inter-tree 0.75 m with 853 trees per rai. However, some of farmers had become experienced in planting trees with 2 x 0.75 m, 1,066 trees per rai. The planting density of trees per rai is closely related to the productivity of leaf yields. This experiment was carried out to check the planting density of mulberry which may have an effect on leaf yields, using the experimental field set up in 1975 [1].

MATERIAL AND METHOD

1. Number and size of block : 16 blocks, each block of 10x10 metres, and two blocks for each treatment.

2. Variety and time of planting . Noi was planted on 21 June, 1975.

3. Fertilizer:

   First year : Applied chemical; 24 kg/rai fertilizer (N-15%, P_2O_5-8%, K_2O-10%) in September.

   Second year : 1) Applied compost; 1000 kg/rai in April 1976 after base cut.

   2) Applied chemical fertilizer: 24 kg/rai in April, July and September, respectively.

   Third and fourth year : Applied as same as the second year.

4. Planting density

Treatment	Inter-tree (m)	Inter-row (m)	Number of tree/rai
1	0 75	3.00	636
2	0 75	2.50	853
3	0 75	2.00	1,066
4	1 00	2.00	800
5	0.50	1.00	3,200
6	0.25	1.00	6.400
7	0.25 x 3	1.00	12,480
8	0 25 x 5	1.00	17,100

5. Training : Base cut, 25 cm in height in April, 1976

6. Harvesting :

   First year : No harvesting.

Second year : Used for propagation, though the amount of leaves were weighed for reference after the second base-cut in September, 1976.

Third and fourth year :

April : Base cut

July : Middle cut, at 1 m in height from the base.

October . Regenerated young shoots after July, are cut at 3 – 5 cm in height from their bases.

February : Regenerated young shoots after October, are cut at 3 – 5 cm in height from their bases.

7. Items to be measured or observed :

(1) Healthiness of trees: The number of healthy, weakened, root-rotted and dead trees are recorded at every harvesting time.

(2) Yield of leaves:

1) The total yield of leaves on the healthy trees are calculated as follows:

Weight of shoots x Percentage of leaves.

2) Percentage of leaves on the harvested shoots are calculated on the basis of

$$\frac{\text{Weight of leaves}}{\text{Weight of shoots}} \times 100$$: about 5 kg of shoots on the middle row are harvested.

3) Growth of trees to be measured on every tree in the middle row.

a) Number of shoots per tree.

b) Length of the longest shoot on each tree.

RESULT

Number and length of shoot in Table 1 showed better results in the low density of stumps than the high. As shown in Table 2, the high density of stumps with the exception of the highest yielded much leaves than in the low. Among three plots of high densities (3,200, 6,400 and 12,480 trees per rai, respectively), however, the plot of 12,480 trees produced the lowest yield. In addition, vitality of stumps in high density became worse than low density.

CONCLUSION

From the data, the more trees planted in a unit area, the more they produced leaves, though in the densely planted plot there were some troublesome works to be operated except for weeding and the increasing unhealthy stumps. As a result, inter-row, 2.00 m, under these conditions, seemed, however, to give a good result in the subsequent growth, yield and field maintenance (such as manuring, watering, weeding etc.).

LITERATURE

1. MANEECHOTE, S. and B. THEPJUNG. An experiment on planting density of mulberry stump for propagation. Bul. Thai Seri. Res. and Train. Centre No. 7, 1977.

Table 1. Number and length of shoot (cm)

Time of harvest / Treatment	July 1978		October 1978		Febuary 1979	
	Number	Length	Number	Length	Number	Length
1	7	263	14	118	20	43
2	6	234	12	113	16	41
3	6	255	16	151	18	51
4	8	250	14	116	22	45
5	8	236	13	137	11	48
6	4	211	9	161	11	36
7	6	205	7	125	8	35
8	2	175	6	133	9	35

Table 2. Yield of leaves (kg/rai)

Time of harvesting / Treatment	July 1978	October 1978	Feburry 1979	Total
1	289	128	172	589
2	345	129	183	657
3	567	346	346	1,259
4	603	146	298	1,047
5	1,385	404	396	2,185
6	2,004	1,219	631	3,854
7	2,522	1,098	911	4,531
8	1,823	796	699	3,318

Table 3. Vitality of stumps

Treatment	All number of stumps	July 1978			October 1978			February 1979			% of helthy stumps	Remarks
		H	W	D	H	W	D	H	W	D		
1	204	102	–	2	102		2	102	–	2	98	H = Healthy
2	150	140	–	10	137	–	13	132	–	18	88	W = Weakened
3	150	121	–	29	121	–	29	121	–	29	80	D = Dead
4	120	95	–	25	94	–	26	90	–	30	75	Died of root-rot
5	400	211	41	148	211	–	189	96	–	304	24	Died of root-rot
6	800	396	22	382	379	–	421	367	–	433	45	
7	1,680	515	73	1,092	514	–	1,166	464	–	1,216	27	
8	2,000	662	157	1,181	568	–	1,185	658	–	1,185	32	

14. Study on Appropriate Amount of Mulberry Leaves for Grown Silkworms (2)

Wanchai SUKCHAROEN and Pornthip PECHMONT

This report dealt with the experimental results in1978, adding the preliminary data in the previous year (1).

The growth of silkworm and cocoon quality are greatly affected with amount of mulberry leaves fed in the 4th and the 5th stages. To decide the proper amount of mulberry in each rearing season is useful to make the plan of multiple rearing in a year for the individual farmer.

This experiment was performed to decide the proper amount of mulberry leaves for production of cocoons with good quality in each season and also to clear the practical characters of grown silkworms under each feeding amount.

MATERIALS AND METHODS

1. Test season : August and October, 1977, January and June, 1978.

2. Silkworm race : K1xK14 and K1xT

3. Lots of test : Randomized complete block design with 4 replications and 5 treatments were used as follows:

Treatment 1	Standard amount of mulberry leaves.
Treatment 2	Increased by 20 percent of the standard.
Treatment 3	Increased by 10 percent of the standard.
Treatment 4	Decreased by 20 percent of the standard.
Treatment 5	Decreased by 10 percent of the standard.

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

The ratio of mulberry leaves distributed to 3 feedings.

6:00 o'clock :	30 percent of whole daily amount.
11:00 o'clock :	30 percent of whole daily amount.
16:00 o'clock :	40 percent of whole daily amount.

5. Number of silkworms

Newly hatched silkworms of 4 grams were reared, mixed together, till 3rd inster, and each 200 old silkworms per treatment were arranged.

6. Items of survey

   1) Terms of the 4th and the 5th stages.

   2) Viability (cocooning ratio and sound pupa ratio to the newly exuviated silkworms of the 4th stage).

   3) Whole cocoon weight.

   4) Cocoon shell weight.

5) Cocoon shell percentage.

6) Temperature and humidity.

RESULT

The results are shown in Tables 1-16.

August rearing season, 1977. In the case of K1xK14, "standard", "20% increased", and "10% increased" lot showed the best results in whole cocoon weight, cocoon shell weight and body weight of silkworm. In the case of K1xT, "20% increased" lot showed the best results in whole cocoon weight, cocoon shell weight and body weight of silkworm.

October rearing season, 1977: In the case of K1xK14, "20% increased lot showed the best results in mounting ratio, sound pupa ratio, whole cocoon weight, cocoon shell weight, cocoon shell ratio and body weight of silkworm. In the case of K1xT, "standard", "20% increased", "10% increased" and "10% decreased" lost showed better results in whole cocoon weight, cocoon shell weight, cocoon shell ratio and body weight of silkworm.

January rearing season, 1978· In the case of K1xK14, "each 20% increased" and "10% increased" lots showed better results in whole cocoon weight cocoon shell weight and cocoon shell ratio. In the case of K1xT, "standard", "20% increased", "10% increased", and "10% decreased" lot showed better results in whole cocoon weight, cocoon shell weight and cocoon shell ratio.

June rearing season, 1978. In the case of K1xK14, "10% increased" lot showed the best results in whole cocoon weight and cocoon shell weight.

In the case of K1xT, "standard", "20% increased" and "10% increased" lots showed better results in whole cocoon weight, cocoon shell weight and cocoon shell ratio.

LITERATURE

(1) Wanchai SUKCHAROEN and Pomthip PECHMONT: Study on appropriate amount of mulberry leaves for grown silkworms Bul. Thai Seri Res. and Train. Centre No. 8, 1978.

Table 1. Analysis of variance of several practical characters, August rearing season, silkworm race: K1xT

SV	df	Mean squares						
		Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Body weight of silkworm (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Total	19							
Rep.	3	48.16	10.22	23 12	0.0251	0 0217	21.89	2.22
Treatment	4	17.76 ns	38.09 ns	73.51 ns	0 0698 **	0.0176 **	7.66 ns	0.66 ns
Error	12	15.56	29.31	86.96	0.0125	0.0017	2.72	0.71
CV (%)		5.3	8.8	18.2	3.2	3.0	6.6	4.6

Table 2. Means of several practical characters (see Table 1)

Treatment	Mounting ratio (%)	Cocooning ratio (T)	Sound pupa ratio (%)	Body weight of silkworm (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Standard amount of mulberry leaves	75 a	66 a	53 a	3.42 b	1.31 cd	24.35 ab	18.46 a
20% increase	74 a	63 a	55 a	3.55 a	1.43 a	26.72 a	18.62 a
10% increase	73 a	62 a	55 a	3.47 b	1.40 ab	24.89 ab	17.72 a
20% decrease	70 a	59 a	49 a	3.20 d	1.26 d	23.05 b	18.18 a
10% decrease	75 a	58 a	45 a	3.34 c	1.36 bc	25.70 ab	18.74 a

From Table 2, means followed by the same common letter are not significantly different at 5% level, using DMRT.

Table 3. ANOVS (Analysis of variances) of several practical characters, August rearing season, silkworm race: K1xK14

SV	df	Mean squares						
		Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Body weight of silkworm (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Total	19							
Rep	3	131.91	124.30	254.65	0.0251	0.0038	9.60	5.48
Treatment	4	56.03 ns	310.31 *	181.94 **	0.0846 **	0.0194 ns	8.21 ns	0.18 ns
Error	12	23.68	61.53	27.17	0.0084	0 0071	5.13	0.52
CV %		6.6	12 2	9.4	2.5	5.9	8.2	3.7

Table 4. Table of means (see Table 3)

Treatment	Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Body weight of silkworm (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Standard amount of mulberry leaves	71 b	62 bc	57 a	3.60 a	1.42 ab	27.85 a	19.52 a
20% increase	80 a	77 a	61 a	3.66 a	1 49 a	28.86 a	19.32 a
10% increase	75 ab	67 ab	62 a	3.67 a	1.49 a	28.61 a	19 07 a
20% decrease	71 b	53 c	47 b	3 37 b	1.33 b	25.29 a	19 04 a
10% decrease	72 b	59 bc	49 b	3.40 b	1.40 ab	27.15 a	19 41 a

From Table 4, means followed by the same common letter are not significantly different at 5% level, using DMRT.

Table 5. ANOVS of several practical characters, October rearing season, silkworm race: K1xT

SV	df	Mean squares						
		Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Body weight of silkworm (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Total	19							
Rep.	3	1.48	8 98	7.50	0.002	0.95	0.20	0.018
Treatment	4	1.86 ns	7.51 ns	5.78 ns	0.011 **	5.88 **	0.40 *	0.022 **
Error	12	3.01	7.39	6 86	0.001	0.59	0.12	0.004
CV %		1.8	2 9	2 8	2.8	3.7	2.0	1.8

Table 6. Table of means (see Table 5)

Treatment	Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Body weight of silkworm (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Standard amount of mulberry leaves	97 a	93 a	93 a	3.3 ab	1.2 a	21.1 a	16.8 ab
20% increase	97 a	95 a	93 a	3.4 a	1.3 a	21.6 a	17.0 a
10% increase	96 a	95 a	94 a	3.4 a	1.2 a	21.4 a	17.2 a
20% decrease	96 a	93 a	92 a	3.2 b	1.1 b	18.6 b	16.3 b
10% decrease	96 a	92 a	91 a	3.3 ab	1.2 a	20 4 a	16.6 ab

From Table 6, means followed by common letter are not significantly different at 5% level, using DMRT

Table 7. ANOVS of several practical characters, October rearing season, silkworm race· K1xK14.

SV	df	Mean squares						
		Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Body weight of silkworm (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Total	19							
Rep.	3	2 75	3 22	5.21	0.002	0.75	0.08	0.005
Treatment	4	3.27 ns	10.92 ns	16 33 ns	0.013 **	8.04 **	0.14	0.041 **
Error	12	3.43	6.43	9.72	0 001	0.55	0.07	0.007
CV %		1.9	2.6	3 3	1.5	2.4	1.3	2.3

Table 8. Table of means (see Table 7)

Treatment	Mount-ing ratio (%)	Cocoon-ing ratio (%)	Sound pupa ratio (%)	Body weight of silkworm (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Standard amount of mulberry leaves	98 a	96 ab	94 ab	3.43 ab	1.54 b	30.25 bc	19.6 ab
20% increase	98 a	98 a	97 a	3.54 a	1.61 a	32.12 a	19.9 a
10% increase	96 a	96 ab	95 ab	3.51 ab	1.56 b	30.75 b	19 6 ab
20% decrease	97 a	95 ab	94 ab	3.29 c	1.46 c	28 50 d	19 4 b
10% decrease	96 a	93 b	91 b	3.39 bc	1.49 c	29.12 cd	19.5 b

From Table 8, means followed by common letter are not significantly different at 5% level, using DMRT.

Table 9. ANOVS of several practical characters, January rearing season, silkworm race: K1xT

SV	df	Mean squares					
		Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell weight (%)
Total	19						
Rep	3	4076.4	3899.3	3783.1	2 5	10.2	1.5
Treatment	4	17.3 ns	22.6 ns	38.8 ns	0 6 ns	3.2 *	0.2 ns
Error	12	22 2	25 6 ns	25.9	0.2	0.7	0.4
CV %		5.8	6.4	6.6	4.1	4 5	3.4

Table 10. Table of means (see Table 9)

Treatment	Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell weight (%)
Standard amount of mulberry leaves	80 a	79 a	75 a	1.09 ab	18.6 ab	17.0 a
20% increase	82 a	79 a	78 a	1.16 a	19 9 a	17.2 a
10% increase	83 a	82 a	80 a	1 14 a	19.6 a	17.3 a
20% decrease	78 a	75 a	72 a	1.05 b	17.6 b	16.8 a
10% decrease	80 a	78 a	75 a	1.09 ab	18.7 ab	17.1 a

From Table 10, means followed by the same common letter are not significantly fidderent at 5% level, uring DMRT.

Table 11. ANOVS of several practical characters, January rearing season, silkworm race: K1xK14

SV	df	Means squares					
		Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell weight (%)
Total	19						
Rep.	3	11.5	27.6	144 3	0.11	0.13	0.30
Treatment	4	3.9 ns	8.4 ns	123.3 ns	1.72 **	14.38 **	1.04 **
Error	12	3.7	7 7	134.1	0.05	0.39	0.08
CV %		1.9	2.8	13.5	1.7	2.5	1.5

Table 12. Table of means (See Table 11)

Treatment	Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell weight (%)
Standard amount of mulberry leaves	98 a	98 a	91 a	1 25 c	24.0 b	19.2 b
20% increase	98 a	95 a	77 a	1.31 a	26.0 a	19 8 a
10% increase	96 a	95 a	87 a	1.32 a	26.2 a	19.8 a
20% decrease	98 a	95 a	88 a	1.17 d	21.8 c	18.6 c
10% decrease	99 a	97 a	83 a	1.21 b	23.3 b	19.2 b

From Table 12, means followed by the same common letter are not significantly different at 5% level, using DMRT.

Table 13. ANOVS of several practical characters, June rearing season, silkworm race. K1xK14

SV	df	Mean squares					
		Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell weight (%)
Total	19						
Rep.	3	26 58 ns	78 82 ns	9.55 ns	0.0006 ns	0.32 ns	0.24 ns
Treatment	4	10.18 ns	15.30 ns	16.42 ns	0.0092 **	5.08*	0.32 ns
Error	12	11.85	37.23	74.02	0 0010	1.11	0.26
CV %		3.9	7.6	11 8	2.3	4.3	2.7

Table 14. Table of means (See Table 13)

Treatment	Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Whole cocoon (g)	Cocoon shell (cg)	Cocoon shell (%)
Standard amount of mulberry leaves	86 a	78 a	70 a	1.27 cd	24.00 bc	18.78 a
20% increase	87 a	82 a	75 a	1.32 b	25.25 ab	19.02 a
10% increase	88 a	79 a	74 a	1.37 a	25.75 a	18.76 a
20% decrease	87 a	79 a	73 a	1.24 d	23.00 c	18.43 a
10% decrease	90 a	83 a	71 a	1.29 bc	23.75 bc	18.33 a

From Table 14, means followed by the same common letter are not significantly different at 5% level, using DMRT.

Table 15. ANOVS of several practical characters, June rearing season, silkworm race: K1xT

SV	df	Mean squares					
		Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell weight (%)
Total	19						
Rep.	3	107.15 *	183.68 ns	205.51 ns	0.0010 ns	0.60 ns	0.24 ns
Treatment	4	68.73 *	113.19 ns	213.54 ns	0.0077 **	5.05 **	0.67 ns
Error	12	18.78	66.0	160.34	0.0012	0.68	0.23
CV %		5.0	10.7	18.1	2.7	3.9	2.9

Table 16. Table of means (see Table 15)

Treatment	Mounting ratio (%)	Cocooning ratio (%)	Sound pupa ratio (%)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell weight (%)
Standard amoung of mulberry leaves	86 ab	70 a	62 a	1.25 ab	21.25 a	16.94 a
20% increase	87 ab	79 a	74 a	1 29 a	21.50 a	16.60 ab
10% increase	92 a	83 a	80 a	1 30 a	21.75 a	16.67 a
20% decrease	83 b	74 a	66 a	1.21 b	19.25 b	15.87 b
10% decrease	81 b	72 a	66 a	1 21 b	19.75 b	16.27 ab

From Table 16, means followed by the same common letter are not significantly different at 5% level, using DMRT.

15. Study on Appropriate Number of Daily Feeding for Grown Silkworm (2)

Wanchai SUKCHAROEN and Sompoti AKAPANTHU

In the previous paper (1) PECHMONT, P. and O. POCHAN reported that the growth of silkworm seemed to be hardly influenced by the number and time of daily feeding, given the adequate amount of daily food according to the current rearing method in the Centre.

The authors tried to investigate appropriate number of daily feeding under the shortage of mulberry leaves supplied to grown silkworms throughout the 4th and the 5th stages (2).

1. Time of test

   (1) 1st test : August 1977
   (2) 2nd test : October 1977
   (3) 3rd test : January 1978
   (4) 4th test : June 1978

2. Silkworm race : K1xT and K1xK14

3. Lots tested : Arranged as follows, on Randomized Compete Blocks with 3 replications.

Amount of leaves supplied throughout 4th and 5th stages	Time of daily feeding	Distributive ratio of leaves in a day
80% of standard amounts supplied	o'clock	%
	6 00	50
	16.00	50
	6.00	30
	11.00	30
	16.00	40
	6 00	20
	9.00	20
	13 00	20
	16.00	40
Standard amounts	The same as the above	The same as the above.

4. Number of silkworms 200 larvae a lot

5. Item of survey : (1) Mounting number (2) Cocooning number (3) Sound pupa number (4) Cocoon weight (5) Cocoon shell weight (6) Cocoon shell percentage

RESULT

The results analyzed statistically are shown in Tables 1-8 and Tables 9-12 of means.

(1) August rearing season: "Standard" was better than "80% of standard" in sound pupa number and cocoon weight in the case of K1xT, and in all items surveyed in the case of K1xK14, as shown in Tables 1 and 2.

(2) October rearing season: In the cases of both K1xT and K1xK14 "standard" was better than "80% of standard" in sound cocoon weight, cocoon weight, and cocoon shell weight. And, 3 times feeding of K1xT showed the best results, but in K1xK14 no significant difference was found out among treatments.

(3) January rearing season:

K1xT : "standard" was better than "80% of standard" in sound cocoon weight, cocoon shell weight and cocoon shell percent.

K1xK14 : "standard" was better than "80% of standard" in sound cocoon weight, cocoon weight, and cocoon shell weight.

(4) June rearing season:

K1xT : "standard" was better than "80% of standard" in sound cocoon weight, cocoon weight, cocoon shell weight, and cocoon shell ratio.

K1xK14 : Standard was better than "80% of standard" in mounting number, cocoon shell weight and cocoon shell ratio.

LITERATURE

(1) PECHMONT, P. and O. POCHAN: Effect of the number and time of daily feeding on the growth of silkworm. Bul. Thai Seri. Res. and Train. Centre, No. 7, 1977.
(2) POCHAN, O. and P. PECHMONT: Study on appropriate number of daily feeding for grown silkworms. Ibid. No. 8, 1978.

Table 1. Analysis of variance, K1xT, August, 1977

SV	df	Mean squares			
		Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight (g)
Total	17				
Replication	2	136.50	4529 39	6480.06	10168.67
Treatment	5	35.30 ns	151.02 ns	634.32	1085.87
80 VS 100 (Q)	(1)	29.30 ns	686.89 ns	2664.50 *	4418.00 **
Number of feeding (T)	(2)	38 17 ns	9.06 ns	243.39 ns	294.50 ns
Q x T	(2)	35 38 ns	20.05 ns	10.16 ns	211.00 ns
Error	10	82.50	231 92	375 92	502.13
CV, %		5.2	11.2	17.6	17.6

Table 2. Analysis of variance, K1xK14, August, 1977

SV	df	Mean squares			
		Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight (g)
Total	17				
Replication	2	76.06	89.56	90.50	80.22
Treatment	5	121.49 ns	394 49 ns	462.13 *	1278.36 *
80 VS 100 (Q)	(1)	355.35 *	1494.00 **	1880.89**	5202.00 **
Number of feeding (T)	(2)	2.72 ns	203.72 ns	113.17 ns	492.75 ns
Q x T	(2)	135.72 ns	35.50 ns	101.72 ns	102.50 ns
Error	10	66.06	138.96	119.03	314.16
CV, %		4.5	8.0	8.5	12.2

Table 3. Analysis of variance, K1xT, October, 1977

SV	df	Mean squares						
		Mounting number	Cocooning number	Sound pupa number	Sound Cocoon weight (g)	Whole Cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Replication	2	10 89	14.39	14 39	68.06	0 0000	0.16	0.14
Number of Feeding (A)	2	2.72 ns	5.06 ns	5.39 ns	293.06 *	0.0046 **	1.50 **	0.02 ns
Amount of mul. (B)	1	1 39 ns	8 00 ns	9.39 ns	1800 00 **	0.0364 **	10.89 **	0.02 ns
A x B	2	7.39 ns	0.16 ns	1.06 ns	29.16 ns	0.0011 ns	0.39 ns	0.05 ns
Error	10	7.22	21.66	18.06	48.06	0.004	0 10	0.05
CV, %		1.3	2.4	2.2	3.0	1.7	1.5	1.3

Table 4. Analysis of variance, K1xK14, October, 1977

SV	df	Mean squares						
		Mounting number	Cocooning number	Sound pupa number	Sound cocoon (g)	Cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Rep	2	3.16	6.50	17.56	218 06	0.0012	1.56	1.50
Number of feeding (A)	2	9.50 ns	16.67	15.72 ns	238.89 ns	0.0007 ns	5.39 ns	1.72 ns
Amount of mul (B)	1	37.56 *	68.06	53.39 ns	2222.22 **	0.0854 **	46.72 **	0.68 ns
A x B	2	7.39 ns	14.89 ns	15.72 ns	372.22 ns	0.0023 **	2.39 ns	0.12 ns
Lrror	10	7.43	13.63	22.69	143.06	0.0002	2.62	1.03
CV %		1.3	1.8	2.4	4.3	1.1	5.7	5 2

Table 5. Analysis of variance, K1xT, January, 1978

SV	df	Mean squares					
		Mounting number	Sound pupa number	Sound cocoon number	Cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Rep.	2	1322.9	1521.7	2814.4	0.0108	8.2	1.8
Number of feeding (A)	2	40.2 ns	22.1 ns	34.3 ns	0.0001 ns	0.7 ns	0.7 ns
Amount of mul. (B)	1	0.5 ns	162.0	868.1 *	0.0032 ns	10.9 **	5.2 **
A x B	2	88.7 ns	109.5 ns	112.1 ns	0.0010 ns	1.6 ns	0.8 ns
Error	10	48.1	41.66	88.52	0.0021	0.6	0.4
CV, %		3.9	3.8	5.4	4.6	4.8	4.0

Table 6. Analysis of variance, K1xK14, January, 1978

SV	df	Mean squares					
		Cocooning number	Sound pupa number	Sound cocoon weight (g)	Cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell weight (%)
Rep	2	304.9	651.1	202.1	0.0030	2.2	0 4
Number of feeding (A)	2	43.7	15.7 ns	43.1 ns	0.0030 ns	0.7 ns	0 6 ns
Amount of mul (B)	1	168.1 ns	162.0 ns	1800.0 *	0.0156 *	16.1 **	2.3 ns
A x B	2	271.7 ns	226.5 ns	529.2 ns	0.0057 ns	0.2	1.6 ns
Error	10	63.8	109.8	194.6	0.0020	0.8	1.2
CV, %		3.9	5.7	6 1	3.7	4 1	5.9

Table 7. Analysis of variance, K1xT, June, 1978

SV	df	Mean squares					
		Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight (g)	Cocoon weight (cg)	Cocoon shell ratio (%)
Rep.	2	98.67	135.39	1,386.06	1805.56	0.0005	0 1272
Number of feeding (A)	2	127.17 ns	214.06 ns	72.06 ns	101.39 ns	0.0023 ns	0.0538 ns
Amount of mul. (B)	1	18.00 ns	60 50 ns	555.56 ns	2688.89 *	0.0355 **	2 2050 **
A x B	2	54.50 ns	285.50	64 39 ns	51.39 ns	0.0015 ns	0.0516 ns
Error	10	43.93	196 99	290.72	277.22	0.0007	0 0978
CV, %		3.6	8.3	12.3	10.1	2.3	1.8

Table 8. Analysis of variance, K1xK14, June, 1978

SV	df	Mean square					
		Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight (g)	Cocoon weight (cg)	Cocoon shell ratio (%)
Rep.	2	261.06	85.72	22 06	38 89	0.0002	0.3905
Number of feeding (A)	2	271 72 **	393.39 ns	184.89 ns	288.89 ns	0.0002	0.0038 ns
Amount of mul. (B)	1	401.39 **	410.89 ns	272 22 ns	1168 06 ns	0.0220 **	1.8688 **
A x B	2	30.72 ns	12.06 ns	14 22 ns	22.22 ns	0.0008 ns	0.2605 ns
Error	10	34.59	371.66	168 86	263.89	0.0009	0.1158
CV, %		3.3	12 5	10 2	10 6	2.6	1.8

Table 9. Table of means, August, 1977

Variety	Number of feeding	Mounting number			Cocooning number			Sound pupa number			Cocoon yield (g)			Whole cocoon weight (g)			Cocoon shell weight (cg)			Cocoon shell ratio (%)		
		80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.
K1×K14	2	177	179	178	143	164	154	119	147	133	139	170	154		–			–			–	
	3	168	188	178	132	154	143	114	136	125	118	162	140		–			–			–	
	4	176	182	179	137	150	144	120	131	126	124	152	138		–			–			–	
	Average	174	183		138	156		177	138		127	162										
K1×T	2	175	173	174	126	143	134	99	122	111	118	151	134		–			–			–	
	3	176	178	177	131	141	136	105	127	116	115	134	124		–			–			–	
	4	169	176	172	129	139	134	90	117	103	100	142	121		–			–			–	
	Average	173	176		128	141		98			111	142										

Table 10. Table of means, October, 1977

Variety	Number of feeding	Mounting number			Cocooning number			Sound pupa number			Cocoon yield (g)			Whole cocoon weight (g)			Cocoon shell weight (cg)			Cocoon shell ratio (%)		
		80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave	80%	100%	Ave.	80%	100%	Ave.
K1×T	2	196	195	195	191	193	192	190	191	191	212	227	219b	1 16	1.23	1.19b	19.0	20.0	19.5c	16.4	16.3	16.4
	3	195	198	196	193	195	194	191	194	192	220	273	232a	1.21	1.29	1.25a	19.7	21.3	20.5a	16.3	16 6	16.4
	4	195	195	195	192	193	193	192	192	192	220	242	231a	1.17	1 29	1.23a	19.0	21.0	20.0b	16.3	16.3	16.3
	Average	195	196		192	194		191	192		217	237		1.18	1.27		19.2	20.8		16.3	16.4	
K1×K14	2	196	192	194	196	190	193	194	187	191	265	275	270	1.40	1.51	1.45	26.3	28.7	27.5	18.9	19.0	19.0
	3	196	196	196	195	195	195	194	194	194	272	288	280	1.38	1.50	1.44	26.7	29.3	28.0	19.2	19.5	19.4
	4	199	195	197	199	194	196	194	192	193	262	302	282	1.37	1.56	1 46	27.0	31 7	29.3	19.7	20.4	20.0
	Average	197	194		197	193		194	191		266	288		1.38	1.52		26.7	29.9		19.3	19.6	

Table 11. Table of means, January, 1978

Variety	Number of feeding	Mounting number			Cocooning number			Sound pupa number			Cocoon yield (g)			Whole cocoon weight (g)			Cocoon shell weight (cg)			Cocoon shell ratio (%)		
		80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.
K1×T	2	179	179	179	167	174	170	–			165	183	174	0 98	1.02	1.00	15.3	18 0	16.7	15.7	17.6	16.7
	3	179	171	175	170	167	168	–			171	175	173	0.97	1.02	1.00	15.7	17.0	16.3	16.1	16.7	16.4
	4	170	177	174	159	173	166	–			159	179	169	1.00	1.00	1.00	15.7	16.3	16.0	15.7	16.3	16.0
	Average	176	176		165	171		–			165	179		0.98	1.01		15.6	17.1		15.8	16.9	
K1×K14	2	171	189	180	157	168	163	–			185	217	201	1.13	1.24	1.18	21.0	22.7	21.8	18.7	18.3	18.5
	3	180	189	184	156	171	164	–			190	220	205	1.16	1.23	1.20	21.0	23.3	22.2	18.1	19.0	18.5
	4	189	180	185	170	162	166	–			207	205	206	1.19	1.18	1 18	21.6	23.3	22.5	18.2	19.8	19.0
	Average	180	186		161	167					194	214		1.16	1.22		21.2	23.1		18.3	19.0	

Table 12. Table of means, June, 1978

Variety	Number of feeding	Mounting number			Cocooning number			Sound pupa number			Cocoon yield (g)			Whole cocoon weight (g)			Cocoon shell ratio (%)		
		80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.	80%	100%	Ave.
K1×T	2	175	183	179	159	168	163	133	146	140	153	178	166	1.15	1.21	1.18	16 3	16 8	16 6
	3	187	182	184	174	162	168	132	136	134	150	168	159	1.11	1.23	1 17	16 2	16 9	16.5
	4	187	190	188	168	182	175	133	149	141	152	182	167	1.10	1.19	1.14	16 0	16.8	16.4
	Average	183	185		167	170		132	144		152	176		1.12	1 21		16.2	16.8	
K1×K14	2	167	180	174	160	167	163	128	134	121	145	163	154	1.13	1.23	1.18	17.6	18.4	18.0
	3	167	177	172	143	153	148	117	123	120	138	150	144	1.17	1.22	1.19	17.9	18.1	18.0
	4	182	187	184	145	157	151	122	134	128	148	167	158	1.15	1.22	1.19	17.6	18.5	18.0
	Average	172	181		149	159		122	130		144	160		1.15	1.22		17.7	18.3	

16. Study on Appropriate Amount of Mulberry leaves for Each Feeding Time

Theera NGARMPRASIT and Sompoti AKAPANTHU

A prime point to be observed in grown silkworm rearing is to protect silkworms against high temperature and humidity and to ensure a sufficient amount of food ingested. PECHMONT, P. and O. POCHAN (1) reported that this growth of old silkworms seemed to be hardly influenced by the number and time of daily feeding, given the adequate amount of daily food.

We intended to find out the proper distributive ratio of leaves needed to each feeding time a day, under the shortage of mulberry leaves supplied to grown silkworms (2).

MATERIAL AND METHOD

1. Time of test and silkworm race used:

(1)	1st test	August 1977	K1xT and K1xK14
(2)	2nd test	October 1977	K1xT and K1xK14
(3)	3rd test	January 1978	K1xT and K1xK14
(4)	4th test	June 1978	K1xT and K1xK14

2. Lots tested: Arranged as follows, on randomized complete blocks with 4 replications.

Amount of leaves supplied throughout 4th and 5th stages	Time of daily feeding		Distributive ratio of leaves in a day
	Lot	Time	
		o'clock	%
80% of standard amounts supplied	A	6.00	40
		11.00	20
		16.00	40
	B	6.00	30
		11.00	20
		16.00	50
	C	6.00	20
		11.00	20
		16 00	60
	D	6.00	30
		11.00	30
		16.00	40
Standard amounts	E	6.00	30
		11.00	30
		16.00	40

RESULT

The results analyzed statistically are shown in Tables 1 – 9 and the suitable ratio may be summarized as follows:

Amount of leaves supplied	Rearing season	Silkworm variety	Distributive ratio of leaves showing better results
80% of standard	August	K1xT	30·20:50
		K1xK14	30:20:50 or 30:30:40
	October	K1xT	30:20:50
		K1xK14	30:20:50
	January	K1xT	30:30:40
		K1xK14	30:30:40
	June	K1xT	40:20:40 or 30:30:40
		K1xK14	30.20:50
Standard amount	August	K1xT	30:30.40
		K1xK14	30:30:40
	October	K1xT	30.30:40
		K1xK14	30:30:40
	January	K1xT	30:30:40
		K1xK14	30:30:40
	June	K1xT	30:30.40
		K1xK14	30:20:50

LITERATURE

(1) PECHMONT, P. and O. POCHAN: Effect of the number and time of daily feeding on the growth of silkworm. Bul. Thai Seri. Res. and Train. Centre, No. 7, 1977.

(2) POCHAN, O. and P. PECHMONT: Study on appropriate number of daily feeding for grown silkworms: Ibid. No. 8, 1978.

Table 1. Analysis of variance, August, 1977, K1xT

SV	df	Mean squares			
		Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight
Total	19				
Replication	3	1063.00	3820.05	3224.85	6466.18
Treatment	4	6.82 ns	61.42 ns	239.95 ns	797.12 *
Error	12	204.96	370.26	109.85	160.89
CV %		8.3	13.4	11.6	11.7

Table 2. Analysis of variance, August, 1977, K1xK14

SV	df	Mean squares			
		Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight
Total	19				
Replication	3	165.52	93.25	74.85	84.45
Treatment	4	702.68 ns	561.18 ns	524.18 ns	1173.62 **
Error	12	225.48	566.54	194.48	274.49
CV %		8.9	11.8	17.3	16.1

Table 3. Analysis of variance, October, 1977, K1xT

SV	df	Mounting number		Cocooning number		Sound pupa number		Sound cocoon weight (g)		Whole cocoon weight (g)		Cocoon shell weight (cg)		Cocoon shell ratio (%)	
		MS	I	MS	F	MS	F	MS	F	MS	I	MS	F	MS	F
Replication	3	13.6500		61.733		33.6500		122.3166		0.0017		1.3125		0.2207	
Treatment	4	4.4500	<1	14.0500	1 19 ns	23.8250	1.39 ns	862.4250	9.03 **	0 0209	19.00 **	14.2000	17.04 **	1.1977	4.39 *
Error	12	8.3166		11.8166		17.1916		0.0011		0.0011		0 8333		0.2730	
CV %		1.5		1.8		2.2		4.8		2.8		4.6		3.1	

Table 4. Analysis of variance, October, 1977, K1xK14

SV	df	Mounting number		Cocooning number		Sound pupa number		Sound cocoon weight (g)		Whole cocoon weight (g)		Cocoon shell weight (cg)		Cocoon shell ratio (%)	
		MS	F	MS	F	MS	F	MS	F	MS	F	MS	F	MS	F
Replication	3	30.1833		31.333		15.8000		145.3333		0.0015		1.4458		0.1248	
Treatment	4	6.8250	<1	26.1250	<1	40.1750	3.88 *	918.5000	6.72 **	0.0232	116.00 **	10 6562	17.11 **	0.2303	1.22 ns
Error	12	19.5583		27.6250		10.3416		136.666		0.0002		0.6229		0.1882	
CV %		2.3		2.7		1.7		4.7		1.0		2.9		2.3	

Table 5. Analysis of variance, January, 1978, K1xT

SV	df	Mean squares						
		Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Replication	3	289.7	235.0	155.5	131.2	0.0014	0.31	0.12
Treatment	4	234.3 ns	297.0 ns	365.2 ns	567.5 *	0.0031 ns	1.12 ns	0.08 ns
Error	12	123.0	174.3	171.3	137.5	0.0019	0.58	0.16
CV %		6.6	8.4	8.6	9.8	4.4	4 9	2.5

Table 6. Analysis of variance January, 1978, K1xK14

SV	df	Mean squares						
		Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Replication	3	15.4	92.4	169.6	190.0	0.0003	0.51	0.11
Treatment	4	35.2 ns	115.3 ns	213.3 ns	910.6 **	0 0076 **	3.08 **	0.03 ns
Error	12	19.0	40.4	81.0	101.4	0.0002	0.44	0.30
CV %		2.2	3.3	5.1	5.5	1.2	3.2	3.0

Table 7. Analysis of variance, June, 1978, K1xK14

SV	df	Mean squares		
		Mounting number	Cocooning number	Sound pupa number
Replication	3	9,029 00 **	9,258,80 **	10,334.73 **
Treatment	4	593,42 ns	797.18 *	1,029.82 *
Error	12	223 79	238 68	297 69
CV %		9.8	12.0	14.7

Table 8. Analysis of variance, June, 1978, K1xK14

SV	df	Mean squares			
		Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Replication	3	9,811.53 **	0 0008 ns	1.1293 ns	0.8565 ns
Treatment	4	311.12 ns	0.0058 ns	5 2192 *	1.8370 ns
Error	12	233.26	0.0030	1.3824	1.0207
CV, %		13.2	4.7	5.8	5.8

Table 9. Analysis of variance, June, 1978, K1xT

SV	df	Mean squares						
		Mounting number	Cocooning number	Sound pupa number	Sound Cocoon weight (g)	Whole Cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell ratio (%)
Replication	3	100.33 ns	442.53 ns	693.38 ns	810 00 ns	0.0017 ns	1 7093 ns	0.8592 ns
Treatment	4	75.18 ns	246.20 ns	419.62 ns	854 38 ns	0 0015 ns	0.6570 ns	0.5908 ns
Error	12	49 21	300.70	368.09	411.04	0.0012	1 1293	0.6738
CV, %		4 0	10 8	12.6	14.5	3.0	5.7	5.0

Table 10. Table of means, August 1977

Variety	Treatment	Mounting number	Cocooning number	Sound pupa number	Cocoon yield (g)
K_1xT	A 80% 40:20:40	174 a	146 a	90 ab	99 b
	B 80% 30:20 50	172 a	148 a	100 a	120 a
	C 80% 20 20.60	170 a	141 a	88 ab	109 ab
	D 80% 30:30:40	172 a	139 a	76 b	89 b
	E 100% 30.30·40	172 a	143 a	95 a	122 a
K_1xK_{14}	A 80% 40.20.40	167 ab	131 ab	67 b	81 b
	B 80% 30·20:50	179 a	135 ab	85 ab	108 ab
	C 80% 20·20 60	147 b	124 b	74 b	99 b
	D 80% 30.30:40	179 a	147 ab	80 ab	98 b
	E 100% 30:30:40	170 ab	153 a	97 a	128 a

Table 11. Table of means, October 1977

Variety	Treatment	Mounting number	Cocooning number	Sound pupa number	Cocoon yield (g)	Whole cocoon weight (g)	Sound shell weight (cg)	Cocoon shell ratio (%)
K1×T	A 80% 40:20:40	195	189	184	187	1.13	18.5	16.23
	B 80% 30:20:50	195	192	189	206	1.16	19.2	16.33
	C 80% 20·20:60	194	188	184	193	1.16	19.1	16.45
	D 80% 30:30:40	194	188	184	207	1.19	19.8	16.63
	E 100% 30:30:40	197	191	188	225	1.32	23.2	17.64
K1×K14	A 80% 40:20:40	196	196	190	242	1.34	25.6	19.16
	B 80% 30:20:50	196	194	190	242	1.39	26.4	19.01
	C 80% 20.20:60	197	197	194	232	1.34	25.8	19.25
	D 80% 30:30:40	198	197	192	259	1.42	27.0	19.08
	E 100% 30.30:40	194	191	186	270	1.52	29.6	19.62

Table 12. Table of means, January 1978

Variety	Treatment	Mounting number	Cocooning number	Sound pupa number	Cocoon yield (g)	Whole cocoon weight (g)	Sound shell weight (cg)	Cocoon shell ratio (%)
K1×T	A 80% 40:20:40	175 a	160 a	155 ab	122 a	0.94 a	15.00 a	15.95 a
	B 80% 30:20·50	168 ab	155 a	150 ab	119 a	0.96 a	15.12 a	15 75 a
	C 80% 20.20:60	170 ab	160 a	158 a	122 a	0.94 a	15 00 a	15.90 a
	D 80% 30:30:40	154 b	142 a	136 b	100 b	0.98 a	15.50 a	15.82 a
	E 100% 30:30·40	169 ab	163 a	158 a	132 a	1.00 a	16.25 a	16.12 a
K1×K14	A 80% 40·20:40	190 a	178 b	164 b	165 c	1.10 c	19.75 b	17.87 a
	B 80% 30:20:50	197 a	191 a	176 ab	185 b	1.14 b	20.62 b	18.00 a
	C 80% 20:20:60	194 a	188 a	174 ab	170 bc	1.11 c	19.87 b	17.87 a
	D 80% 30:30·40	194 a	187 ab	177 ab	181 b	1.12 bc	20.00 b	17.87 a
	E 100% 30:30:40	197 a	192 a	184 a	204 a	1.21 a	21.87 a	18.05 a

Table 13. Table of means, June, 1978

Variety	Treatment	Mounting number	Cocooning number	Sound pupa number	Cocoon yield (g)	Whole cocoon weight (g)	Sound shell weight (cg)	Cocoon shell ratio (%)
K1×T	A 80% 40.20·40	172 a	150 a	142 a	126 b	1.09 a	18.02 a	16.47 a
	B 80% 30.20·50	176 a	164 a	154 a	141 ab	1 13 a	18.17 a	15.97 a
	C 80% 20·20.60	179 a	170 a	167 a	162 a	1.14 a	18.37 a	16.05 a
	D 80% 30.30·40	168 a	154 a	142 a	128 b	1 13 a	18.17 a	16.05 a
	D 100% 30.30·40	175 a	161 a	154 a	138 ab	1.13 a	19.05 a	16.87 a
K1×K14	A 80% 40.20·40	131 b	104 b	95 b	111 a	1.13 a	18.50 b	16.70 a
	B 80% 30.20.50	155 a	133 a	120 ab	115 a	1.19 a	21.07 a	17.62 a
	C 80% 20:20:60	161 a	142 a	138 a	131 a	1.20 a	20.12 ab	16.77 a
	D 80% 30:30.40	158 a	133 a	123 ab	108 a	1.13 a	20.20 ab	17.82 a
	E 100% 30·30.40	154 ab	127 ab	109 b	110 a	1.19 a	21.60 a	18.07 a

17. Study on Silkworm Rearing by Arrangement of Mulberyy Leaves in Different Position

Theera NGARMPRASIT and Sompoti AKAPANTHU

On silkworm rearing the suitable arrangement of mulberry leaves supplied to silkworms is useful to their high productivity of cocoons, we tried to find better way in arranging mulberry leaves for feeding silkworms.

MATERIAL AND METHOD

1. Time of feeding: (1) 1st test: August, 1978 (2) 2nd test: October, 1978

2. Variety: K1xK14

3. Lots tested: R.C.B. with 5 treatments and 4 replications

   (1) Feeding with mulberry leaves by turning downward the surface.
   (2) Feeding with mulberry leaves by turning upward the surface.
   (3) Feeding with mulberry leaves by setting upright on the bed.
   (4) Feeding with the said three kinds of leaves, mixed on the bed.
   (5) Feeding with mulberry leaves to branch.

4. 3 times 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:

Old silkworm larvae, 100x4 rep./treatment, collected at ramdom from silkworms immediately after 3rd molting.

RESULT

The results are shown in Tables 1, 2, 3 and 4. Cocoon weight and cocoon shell weight in "branch lot" were superior to the others.

Table 1. Analysis of variance, August, 1978

SV	df	Mounting number		Cocooning number		Sound pupa number		Sound cocoon weight (g)		Whole cocoon weight (g)		Cocoon shell weight (cg)		Cocoon shell percent (%)	
		MS	F	MS	F	MS	F	MS	F	MS	F	MS	F	MS	F
Rep.	3	4.0500		4.600		192 6000		110.000		0 0008		0.5500		0.0925	
Treatment	4	8.9250	1.39 ns	8.9250	1.39 ns	49.4500	1	190.6250	1.57 ns	0.0113	15.24 *	5.0188	5.89 **	0.0195	1
Error	12	6.4250		6.4250		62.6833		121.4583		0.0007		0.8521		0.1408	
CV %		1.3		2 9		4.5		4.2		1.9		3.1		1.8	*

Table 2. Means (Hakitate: August 15, 1978)

Treatment	Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight (g)	Cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. Downword	198	194	180	262	1.42	29.1	20.4
2. Upward	195	191	177	269	1.43	29.2	20.5
3. Uplight	197	192	178	258	1.39	28.6	20 6
4. Mixed	195	190	174	261	1.42	29.2	20.6
5. Branches	198	190	171	275	1 53	31.5	20.6
LSD 0.05	–	–	–	–	0.04	1.4	–
LSD 0 01	–	–	–	–	0.06	2.0	–

Table 3. Analysis of variance, October, 1978

SV	df	Mounting number		Cocooning number		Sound pupa number		Sound cocoon weight (g)		Whole cocoon weight (g)		Cocoon shell weight (cg)		Cocoon shell percent (%)	
		MS	F	MS	F	MS	F	MS	F	MS	F	MS	F	MS	F
Rep.	3	34 7166		85 333		135.6500		5200.000		0.0029		1.0125		0.0940	
Treatment	4	21.8250	< 1	29.3750	< 1	29.5750	< 1	304.3750	1.26 ns	0.0326	14.16 **	8.5188	9.27 **	0.1008	
Error	12	30.4250		51.3750		60.1083		241.8750		0.0023		0.9188		0.0844	
CV %		2.8		3.8		4.1		5.0		2.7		2.9		1 5	

Table 4. Means (Hakitate: October 15, 1978)

Treatment	Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. Downward	192	188	188	298	1.71	32.5	19.0
2. Upward	197	192	192	318	1.75	33.4	19.0
3. Upright	195	189	189	302	1.69	32.4	19.2
4. Mixed	198	194	195	316	1.68	32.0	19.0
5. Branches	196	192	190	311	1.90	35.6	18.7
LSD 0.05	–	–	–	–	0.07	1.5	–
LSG 0.01	–	–	–	–	0.10	2.1	–

18. Effect of Juvenile Hormone (Manta) on the Growth of Silkworm at the 5th Stage (a Preliminary Note)

Sompoti AKAPANTHU

Yokichi KOBARI and Hiromu AKAI (1), (2) 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 C131xN136, a Japanese silkworm variety. We tried to test this effect in our laboratory where climatic factors and silkworm variety are different from Japan.

MATERIAL AND METHOD

1. Time of test and silkworm race tested:

   January 15 – February 15, 1979 and K1xK14

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 Compelte 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 and 2 Unexpectedly, the activities of juvenile hormone sprayed showed hardly clear effects on qualities of cocoons among treatments under these rearing conditions. This experiment is to be continued

LITERATURE

(1) KOBARI, Y. and H. AKAI: Utilization of the Manta (synthetic compound with juvenile hormone activity) for the silkworm rearing. Jour. Seri. Japan. 47 (4), 1978
(2) KING R. C.: Handbook of Genetics Vol. 3. 1976 New York.

Table 1. Analysis of variance

SV	df	Mounting number		Sound pupa number		Sound cocoon weight (g)		Whole cocoon weight (g)		Cocoon shell weight (cg)		Cocoon shell percent (%)	
		MS	F	MS	F	MS	F	MS	F	MS	F	MS	F
Rep.	3	176.5833		154.4500		1048.3333		0 0074		2.4500		0.3660	
Treatment	4	41.1250	< 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 (K1xK14: Hakitate, Jan. 15) February, 1979

Treatment	Mounting number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. Control	189	185	280	1.54	31.8	20 6
2. 0 hour	193	191	285	1.57	32.0	20.4
3. 24th hour	185	182	279	1.58	32.2	20.4
4. 48th hour	192	188	284	1.58	31.2	19.8
5 72th hour	192	188	285	1.58	31 0	19 7
LSD 0.05					0.8	0.6
LSD 0.01					1.1	0.9

19. An Experiment on Rearing of Silkworms Fed on Mulberry Leaves Sprayed with Urea

Bhinai HONGTONGDAENG and Sompoti AKAPANTHU

This experiment was carried out to know the effects of mulberry leaves sprayed with urea on the growth of silkworms to be fed on these leaves.

MATERIAL AND METHOD

1. Time of test : January 15 – February 15, 1979

2. Lot of test : CRD, 4 treatments and 5 replications

   (1) Control: Not sprayed

   (2) Fed on mulberry leaves sprayed with urea solution, 2 kgs/rai, before 7 days of Hakitate.

   (3) Fed on mulberry leaves sprayed with urea solution, 2 kgs/rai, before 14 days of Hakitate.

   (4) Fed on mulberry leaves sprayed with urea solution, 2 kgs/rai, before 21 days of Hakitate.

3. Varieties.

   (1) Silkworm variety : K1xK14
   (2) Mulberry variety : Soi

4. Number of silkworms

   (1) Young stage : 0.2 gms/treatment
   (2) Old stage : 200 larvae x 5 replications/treatment

RESULT

From the results seen in Tables 1 and 2, cocoon shell weight of "7 days lot" seemed slightly good among treatments.

In addition, no harmful or suitable effects of spraying with urea on the uniformity of growth throughout young and old stages of silkworms were noticeable.

Table 1. Analysis of variance

SV	df	Mounting number		Sound pupa number		Sound cocoon weight (g)		Whole cocoon weight (g)		Cocoon shell weight (cg)		Cocoon shell percent (%)	
		MS	F	MS	F	MS	F	MS	F	MS	F	MS	F
Treatment	3	0.4000	< 1	5.6666	< 1	384.5833	2.18 ns	0.0014	< 1	2.8000	4.15 *	0.3927	< 1
Error	16	44.8000		44.2000		176.2500		0.0019		0.6750		0.4438	
CV %		3.5		3 5		4.8		2.9		2.7		3.3	

Table 2. Means

Treatment	Mounting number	Cound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. Control	193	190	274	1.53	30.0	19.6
2. Sprayed before 7 days	193	189	288	1.56	31.8	20.3
3. Sprayed before 14 days	193	190	270	1.53	30 6	20.0
4. Sprayed before 21 days	193	192	269	1.54	30.8	20.1
LSD 0.05	–	–	–	–	1.1	–
LSD 0.01	–	–	–	–	1.5	–

20. An Experiment on Silkworm Rearing with Different Parts of Mulberry Shoots

Parn PANNENGPET, Sompoti AKAPANTHU and A. MUROGA

The quality of mulberry leaves are different by their position on the branch. We tried to find out the fittable leaves among different positions on branches in the practices of 5th instar silkworm rearing to increase the cocoon yield. The experiment was carried out at the Sericulture Department, National Sericultural Experiment Station, M.A.F.F., Japan, where PANNENGPET and AKAPANTHU stayed for about one month, 1978.

MATERIAL AND METHOD

1. Time of test : August 29, 1978 – September 25, 1978.

2. Lot of test : Factorial design with 3 factors

   Factor A: Type of mulberry supplied.

   (1) Mulberry leaves
   (2) Mulberry, whole branches
   (3) Mulberry, upper parts of branches
   (4) Mulberry, lower parts of branches

   Note: Absolute leaves supplied throughout 5th instar: 25 kg.

   Factor B: Times of bed cleaning

   (1) 2 times in the 5th instar
   (2) 3 times in the 5th instar

   Factor C: Rearing type

   (1) Wooden tray rearing bed
   (2) Iron rearing tray

3. Time of feeding and distributive ratio

   8.00 o'clock, 25% of daily judging amount
   13.00 o'clock, 25% of daily judging amount
   18.00 o'clock, 50% of daily judging amount

4. Number of silkworm reared . Variety, N137 x C137
   Young silkworm larvae : 8.7 gms (20,000 larvae)
   5th instar silkworms : 1,000 larvae/lot, collected at random from 20,000 larvae in preparation.

RESULT

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

Cocoon weight and cocoon shell weight showed the best results in the case of "upper part" lot, folllowed by "whole branch". Furhter, 3 times bed cleaning in the case of rearing on wooden tray proved to be good.

Table 1. Analysis of Factor A, type of mulberry leaves supplied

Means / Varieties	Cocoon weight (g)	Cocoon shell weight (cg)
Leaves	1.5238 c	35.2250 c
Whole branches	1.6338 b	38.7500 b
Upper parts	1.7675 a	42.1625 a
Lower parts	1.5063 c	34.3375 d
	LSD 0 05: 0.0334 LSD 0 01: 0.0613	LSD 0.05. 0.8305 LSD 0.01: 1.5245

Table 2. Analysis of Factor B x C in cocoon weight

Time of bed cleaning / Rearing tray	Whole cocoon weight (g)		Different value
	2 times	3 times	
Wooden	1.5900	1.6338	0.0438 *
Iron	1.6063	1.6013	0.005
	LSD 2 (BxC) 0.05=0.0334 0.01=0.0613		

Table 3. Analysis of Factor BxC in cocoon shell weight

Time of bed cleaning / Rearing tray	Cocoon shell weight (cg)		Different value
	2 times	3 times	
Wooden	36.9125	38.3500	1.4375 *
Iron	37.7250	37.4875	0.2375
	LSD 0 05=0.8305 LSD 0.01=1.5245		

21. Variety test of Bivoltine Parent Silkworm Races

Wanchai SUKCAHROEN and Sompoti AKAPANTHU

We have many pure bivoltine silkworm races which were improved by Breeding Section in our Centre. Some of them are very useful to parent silkworm for hybridization.

This test aims at being familiar with the parent races of the current F_1 hybrid in the sericultural practices.

MATERIAL AND METHOD

1. Time of test and silkworm race used:

   (1) August 15 – September 15, 1978
   (2) Race: T, K1, K6, K8, and K14

2. Number of silkworms

   (1) Young stage: 2 batches/treatment (race)
   (2) Old stage : 800 larvae (200 larvae x 4 rap.)/treatment (race)

3. Time of 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

From the results shown in Tables 1 and 2, it was found out that sound cocoon weight, whole cocoon weight, cocoon shell weight and cocoon shell percent of both K8 and K14 races were superior to others.

Table 1. Analysis of variance

SV	df	Mounting number		Cocooning number		Sound pupa number		Sound cocoon weight (g)		Whole cocoon weight (g)		Cocoon shell weight (cg)		Cocoon shell percent (%)	
		MS	F	MS	F	MS	F	MS	F	MS	F	MS	F	MS	F
Rep.	3	13.3333		34.8000		370.1833		754.5833		0.0012		0.2780		0.1053	
Treatment	4	4.1750	< 1	3.3250	< 1	489.3000	2.24 ns	14729.3750	16.08 **	0.1028	12.25 **	143.2625	21.18 **	21.3468	16.14 **
Error	12	12.7083		23.2583		218.4333		916.0416		0.0084		6.7655		1.3224	
CV %		1.8		2.5		8.9		11.4		5.6		8.4		6.1	

Table 2. Means of sound cocoon weight

Varieties	Mounting number	Cocooning number	Sound pupa number	Sound cocoon weight (g)	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
1. T	196	195	160	170	1.38	23.1	16.8
2. K1	198	196	150	251	1.63	26.4	16.2
3. K8	196	194	179	324	1.77	36.4	20.5
4. K14	196	194	172	310	1.77	35.1	19.9
5. K6	196	193	166	271	1.63	34.8	21.3
LSD 0.05	–	–	–	47	0.14	4.0	1.8
LSD 0.01	–	–	–	65	0.20	5.6	2.5

22. Variety Test of Native Polyvoltine Silkworm Races

Chaum KAMKLA*, Thienchai UNCHITVATANA*, Buared TOOKMAI*,
Thiensak ARIYA* and Sompoti AKAPANTHU
(* The Buriram Sericultural Experiment Station)

Native polyvoltine silkworm races are serviceful to produce cocoons for weft of Thai Silk which is under heavy pressure from silk industry. Using the current native varieties collected at the Buriram Sericultural Experiment Station, we tried to find out the best one in order to pave the way for mass production of eggs and to distribute them more widely to farmers.

MATERIAL AND METHOD

1. Time of test and silkworm race tested.

   (1) 1st test : November, 1977
   (2) 2nd test . January, 1978
   (3) Races : Nongkai 4, Nongkai 5, Pakchong 21, Roi-ed 3 and 15 KY

2. Number of silkworm

   (1) Young silkworm : 1.2 gms/race
   (2) Old silkworm : 1600 larvae (400 larvae x 4 rep.)

3. Place. Buriram Sericultural Experiment Station

RESULT AND CONSIDERATION

From the results in November shown in Table 2, Pakchong 21 was better, followed by Nongkai 5 in cocoon weight and cocoon shell weight, though in January there was no significant difference among races.

Table 1. Analysis of variance (November, 1977)

SV	df	Mean square					
		Mounting number	Cocooning number	Sound pupa number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Rep.	3	129.8	133.7	519.6	0.0023	0.45	1.11
Treatment	4	91 3 ns	66 2 ns	336.3	0.0039 ns	1.82 ns	0.69 ns
Error	12	138.4	195.8	326 0	0.0018	0.66	0.57
CV %		3.0	3 6	4.9	4.5	7.2	6.1

Table 2. Table of means (November, 1977)

Treatment	Mounting number	Concooning number	Sound pupa number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Pakchong 21	385 a	377 a	357 a	0.97 a	12.25 a	12.77 a
Roi-ed 3	392 a	380 a	373 a	0.93 ab	11.00 ab	11.80 a
Nongkai 4	388 a	372 a	352 a	0.88 b	10.50 b	11.85 a
Nongkai 5	384 a	380 a	368 a	0.93 ab	11.25 ab	12.40 a
15 KY	396 a	382 a	371 a	0.92 ab	10.75 b	12.00 a

Table 3. Analysis of variance (January, 1977)

SV	df	Mean square					
		Mounting number	Cocooning number	Sound pupa number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Rep.	3	198.4	403.5	1345.7	0.0010	0.18	0.48
Treatment	4	131.0 ns	244.3 ns	216.6 ns	0.0010 ns	0.32 ns	0.31 ns
Error	12	113 8	198.1	647.9	0.0008	0.22	0.89
CV %		2.8	3.7	7.2	3.3	4.0	6.8

Table 4. Table of means (January, 1978)

Treatment	Mounting number	Cocooning number	Sound pupa number	Whole cocoon weight (g)	Cocoon shell weight (cg)	Cocoon shell percent (%)
Pakchong 21	370 a	362 a	340 a	0.88 a	12.25 a	13.90 a
Roi-ed 3	384 a	379 a	350 a	0 87 a	12.00 a	13.67 a
Nongkai 4	378 a	368 a	348 a	0.85 a	11.75 a	13.60 a
Nongkai 5	372 a	364 a	354 a	0.89 a	11.50 a	14.20 a
15 KY	381 a	377 a	360 a	0.89 a	11.75 a	13.50 a

23. Training on Silkworm Rearing in Last One Year

Wollapa NGARMPRASIT and Wichien KWON-ON

In last year (Feb. 15, 1978 – Feb. 12, 1979) we had four times of short term training work in addition to four times of routine training as shown in Table 1.

Every training, including special items in the short term 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	Trainee			
		Occupation	Man	Woman	Total
Short term	Feb. 15 – 19, 1978	P.W.D. Supervisor	7	3	10
Short term	Feb 27 – March 2, 1978	Sericultural Experiment Station Officer	23	1	24
Short term	Apr. 17 – 21, 1978	P.W.D Officer	16	1	17
31st	Junt 16 – July 13, 1978	A.R D. Officer	14	1	15
		Cooperative Extension Officer	1	–	1
		A.R.D Farmer	1	8	9
		Total	16	9	25
32nd	Aug. 11 – Sept. 12, 1978	Extension Officer	50	2	52
33rd	Oct. 12 – Nov 12, 1978	Land Reform's Farmer	1	29	30
		P.W.D. Officer	13	1	14
		Total	14	30	44
Short term	Nov. 6 – 15, 1978	P.W.D. Officer	7	3	10
34th	Jan 12 – Feb. 12, 1979	Extension Officer	45	6	51
	Grand total		178	55	233

24. Survey on the Practical Characters of a New Strain of Japanese Bivoltine Silkworm, K13 (A8)

Paiwan LEKUTHAI, Sutathip BUTRACHUND and Sompong KRAIPOT

To raise the productivity of bivoltine silkworm races for cocoon production of warp for Thai Silk, we have been carrying out breeding of bivoltine races instead of Thai polyvoltine ones which could not produce good cocoons for warp. 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. Continued improvement has produced a new strong and highly productive strain, K13 (old breeding symbol, A8), using K6 and K1, both the fixed races in our breeding section (1) (2). A new strain, K13, a pure Japanese bivoltine race, will be useful to production of practical hybrids to be extended in the near future. The breeding process of the strain is described as under.

MATERIAL AND METHOD

Our breeding started from F_1 hybrid of K6 (female) and K1 (male) in1974. K6, originated from a Japanese bivoltine race, was high in productivity, but low in viability, while K1, another Japanese bivoltine race, was high in viability, but low in productivity. From the beginning till now. K13 has been just selected for 18 generations. In the breeding process, individual selection was continued during 1st – 5th generations, and after that batch selection was repeated to rear better batches in the next season. 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.

K13, among the current parent races including K6 and K1, showed higher productivity and viability and the following good characters could be seen: Easy to rear, uniformity in growth, stoutness, high egg laying ability etc. And, it is expected that K13 may be promising as a parent race of new practical combinations to be distributed to farmers from the results of F_1 hybrid test (Table 4). Further, the batch selection is to be continued to find better linage with good quality of cocoon in the next year.

LITERATURE

(1) LEKUTHAI, P.: Survey on the practical characters 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 silkworm races, T, K1, K6 and K14 in 1976. Ibid. No. 7, 1977.

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

Date of "HAKITATE"	Temperature, °C			Humidity %
	Maximum	Minimum	Average	
Jan. 25, 1978	37.0	20.0	28.1	73
June 18, 1978	36.5	23.5	28.7	79
Aug. 15, 1978	37.0	23.5	29.8	73
Oct. 16, 1978	32.5	18.5	26.0	79

Table 2. Process of batch selection of K13

Rearing season		Generation	No. of batches reared	Lineage
				K6 × K1
1974	Aug.	1	1	87
	Oct.	2	1	73
1975	Jan.	3	1	82
	June	4	1	112
	Aug.	5	1	121
	Oct.	6	9	100 103 102 106
1976	Jan.	7	7	41 42 36 39
	June	8	7	64 65 67 68
	Aug.	9	7	70 71 66 69
	Oct.	10	7	61 62 64 66 67
1977	Jan.	11	5	51 55
	June	12	6	46 49 47 48
	Aug.	13	7	59 58 60 61
	Oct	14	7	59 60 61 58
1978	Jan.	15	8	62 63 66
	June	16	8	60 61 56 59
	Aug.	17	8	63 59 58 57 60
	Oct.	18	8	77 79 80 84

Table 3. Practical characters on selection of K13

Generation	No.	Lineage	Term 1–5 stage	Cocoon-ing ratio	Sound pupa ratio	Whole cocoon weight	Cocoon shell weight	Cocoon shell ratio	No. of eggs laid
			d . h	%	%	g	cg	%	
	61	60x59	22.20	95 7	93.7	1.22	24.6	20.2	
	62	60x59	22.20	97.3	97.0	1.17	23.2	19.8	
	63	60x59	22.04	96.7	96.0	1.18	23 8	20.2	
15th	64	60x59	22.20	96.7	95.3	1.22	25.4	20.8	
(Jan. '78)	65	60x59	21.22	95.7	93.7	1.15	23 0	20.0	
	66	61x58	22.20	97.0	96.3	1.14	23.2	20.4	
	67	61x58	22 20	95.3	94.7	1.08	21.6	20.0	
	68	61x58	23.00	96.3	96.0	1.12	22 4	20.0	
Average			22.16	96.3	95.3	1.16	23.4	20.2	428
	56	63x66	20 04	96.0	90.3	1.30	26.6	20.5	
	57	63x66	20.04	97.3	93.0	1.32	26.8	20.3	
	58	63x66	20.04	94.7	87.0	1.31	26.8	20.5	
16th	59	63x66	20.20	97.7	92.3	1.33	27.4	20.6	
(Jun. '78)	60	63x62	20.04	97.7	94.0	1.31	26.8	20.5	
	61	63x62	20.04	96.3	90.7	1.37	27.8	20.3	
	62	63x62	20.20	94.7	87.0	1.34	27.2	20.3	
	63	66x62	20 04	94.7	87 0	1.32	27.0	20.5	
Average			20.08	96.1	90.2	1.33	27.1	20.4	440
	56	59x61	22.04	98.0	93.3	1.13	23.6	20.9	
	57	59x61	22.22	95.3	87.7	1.30	26.8	20.6	
	58	59x61	22 22	98.0	94.3	1.23	24.2	19.7	
17th	59	59x61	22.22	97.3	92.7	1.28	25.8	20.2	
(Aug. '78)	60	59x61	22 22	97.7	92.0	1.25	26.2	21.0	
	61	60x56	22.04	96.7	92.3	1.26	24.6	19.5	
	62	60x56	22 22	95.7	95 7	1.21	23.8	19.7	
	63	60x56	22.22	97.3	91.0	1.29	27.0	20.9	
Average			22.18	97.0	92.4	1.24	25.3	20.3	437
	77	59x63	22.21	99.3	93.0	1.40	30.0	21.4	
	78	59x63	22.21	98.7	97 3	1.36	28.4	20.9	
	79	59x63	22.21	99.0	92 7	1.40	30.6	21.9	
18th	80	59x63	22.21	99.0	96.0	1.39	30 0	21.6	
(Oct. '78)	81	60x58	22.21	98.0	92.0	1.32	27.4	20.8	
	82	60x58	22.21	98.3	92 3	1.33	27.6	20.8	
	83	60x58	22.21	97.3	91.0	1.32	27 2	20.6	
	84	57x60	22.23	98.7	92.7	1.38	28.8	20.9	
Average			22.21	98.5	93.4	1.36	28.8	21.1	508

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

Table 4. Comparison of practical characters of F_1 hybrids

Season	Race	Term 1–5 stage	Cocooning ratio	Sound pupa ratio	Whole cocoon weight	Cocoon shell weight	Cocoon shell ratio
		d . h	%	%	g	cg	%
Oct. '78	K13xK8	23.00	99.0	98.3	1.68	35.8	21.3
	K13xK16	23.00	99 3	98.3	1.68	34.6	20.6
	K13xK18	23.00	98.3	98 0	1.66	34.8	21.0
	Kinshu x Showa	24.00	98.0	94.7	1.77	39.8	22.5

25. Survey on the Practical Characters of Two New Strains of Chinese Bivoltine Silkworm, K16 (A10) and K18 (A11)

Paiwan LEKUTHAI, Suthathip BUTRACHUND and Sompong KRAIPOT

We have had many Chinese bivoltine silkworm races to be improved, but they were not enough for egg production ability. And, some of them showed unsatisfactory combining ability in the hybrid test, though a few varieties such as T, K8 and K14 had been well known to be useful ones in the sericultural practices. For the further development of silk production, it is essential to have new Chinese silkworm races having both high combining ability and practical use.

Keeping on with the previous report (1), we deal with two promising Chinese bivoltine races, K16 and K18, bred in our section. Breeding of the new strains have been continued for four years ago as under.

METHOD

Our breeding for K16 (old breeding symbol, A10) and K18 (All) started with cross breeding method, using silkworms of K7xK10 and $H6xK8^3$ in 1974 and 1975, respectively. Pure races were selected with individual selection and then batch selection was repeated (Tables 1 and 2). Both K16 and K18 produced elliptcal cocoon. In K18, a sex-limitted race, we can segregate male and female with larval pattern. Female larva has mark of eye spot on the thorax, lunar spot and star spot on the back of abdomen, while male has not any marks.

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 weight and ratio of cocoon shell.
4. Eggs laying ability

RESULT

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

Better batches were selected as the parents of next generation.

Table 1. Process of batch selection of K16 (A10)

Rearing season		Generation	No. of batches reared	Lineage
1974	Aug	1	1	K7 × K10
	Oct.	2	1	No. 75
1975	Jan.	3	1	84
	June	4	1	114
	Aug	5	1	123
	Oct.	6	1	125
1976	Jan.	7	3	49 50
	June	8	8	78 79 80 84
	Aug.	9	7	81 84
	Oct	10	6	74 78
1977	Jan.	11	5	61 62 65
	June	12	6	59 61 62 63
	Aug.	13	6	71 72 74 75
	Oct.	14	6	70 71 74 75
1978	Jan.	15	8	76 72 73
	June	16	8	66 68 69 70
	Aug.	17	8	68 69 70 71
	Oct.	18	8	61 64 66 67 68

Table 2. Process of batch selection of K18 (A11)

Rearing season		Generation	No. of batches reared	Lineage
1975	Jan.	1	1	H6 x K8[3]
	June	2	1	No. 115
	Aug.	3	1	124
	Oct.	4	1	126
1976	Jan.	5	1	63
	June	6	1	115
	Aug.	7	1	115
	Oct.	8	1	105
1977	Jan.	9	1	73
	June	10	6	66 67 68 69
	Aug.	11	6	80 81 77 79
	Oct.	12	6	76 77 78 79 80 81
1978	Jan.	13	6	77 78 81
	June	14	8	72 73 76 79
	Aug.	15	8	72 76 78 79
	Oct.	16	8	71 72 73 74

Table 3. Temperature and humidity in rearing room during rearing period

Rearing season	Temperature (°C)			Humidity (%)
	Maximum	Minimum	Average	
Jan. 1978	37.0	20.0	28.1	73
June 1978	36.5	23.5	28.7	79
Aug. 1978	37.0	23.5	29.8	73
Oct. 1978	32.5	18.5	26.0	79

Table 4. Practical characters on selection of K16 (A10)

Generation	No.	Lineage	Term 1–5 stage	Cocoon-ing ratio	Sound pupa ratio	Whole cocoon weight	Cocoon shell weight	Cocoon shell ratio	No. of eggs laid
			d . h	%	%	g	cg	%	
	69	71x75	22.20	98 3	96.7	1.14	21.2	18.6	
	70	71x75	22 22	94.7	94.3	1.15	21.4	18.6	
	71	71x75	23.05	96 0	95.0	1.20	22.6	18.8	
15th	72	71x75	23.05	98.0	97.3	1.15	21.8	19.0	
(Jan. 25,	73	71x75	23.05	99.0	98.3	1.17	22.4	19.1	
1978)	74	70x74	22.22	92 9	91.3	1.18	22 6	19.2	
	75	70x74	22.22	97.7	97.7	1.16	22.2	19.1	
	76	70x74	23.05	97.3	96.7	1.20	23.2	19.3	
Average			23.01	96 7	95.9	1.17	22.2	19.0	416
	64	76x73	20.04	47 0	43.7	1.38	26.4	19.1	
	65	76x73	20.20	96.3	95.0	1.27	24.8	19 5	
	66	76x73	20.20	96 7	94.7	1.25	24.4	19.5	
16th	67	76x73	20.04	94.7	93.7	1.32	24.8	18.8	
(June 18,	68	76x72	20.20	97 0	95.7	1.28	24.8	19.4	
1978)	69	76x72	20.04	97.7	96.0	1.34	24.8	18.5	
	70	76x72	20 22	97.3	94.0	1.29	25.4	19.7	
	71	73x72	20.04	96 0	93.7	1.31	25.0	19.1	
Average			20.12	90.3	88.3	1.31	25.1	19.2	394
	64	66x68	22.22	90.7	89.3	1.15	21.0	18.3	
	65	66x68	22.22	95.3	93.7	1.13	19.6	17.3	
	66	66x68	22.04	94.3	90.3	1.13	20.4	18.1	
17th	67	66x68	22.22	93.7	91.7	1.15	20.6	17.9	
(Aug. 15,	68	66x68	22.04	94 0	92.7	1 16	21.4	18.4	
1978)	69	69x70	21.22	99.3	99.3	1.18	22.2	18.8	
	70	69x70	22.04	96.3	94.3	1.16	22.0	19.0	
	71	69x70	21.22	96 3	95.3	1.18	23.0	19.5	
Average			22.09	95.0	93.3	1.16	21.3	18 4	310
	61	70x69	22.23	98.5	98.5	1.37	26.0	19.0	
	62	70x69	23.16	96.3	95.7	1.29	24.6	19.1	
	63	70x69	23.21	96.0	94.7	1.41	27.0	19.1	
18th	64	70x69	23.21	97.7	96.0	1.37	25.6	18.7	
(Oct. 15,	65	70x69	23.21	96.0	94.7	1 33	24.8	18.6	
1978)	66	71x68	23.21	98.7	97.7	1.37	25.2	18.4	
	67	71x68	23.23	97.3	96.7	1.36	25.4	18.7	
	68	71x68	23.21	98.7	97.7	1.31	24.6	18.8	
Average			23.18	97.4	96.5	1.35	25.4	18.8	449

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

Table 5. Practical characters on selection of K18 (A11)

Generation	No.	Lineage	Term 1–5 stage	Cocoon-ing ratio	Sound pupa ratio	Whole cocoon weight	Cocoon shell weight	Cocoon shell ratio	No. of eggs laid
			d . h	%	%	g	cg	%	
	77	77x78	21.22	95.3	92.7	1.00	19.8	19.8	
	78	77x78	21.22	94.0	93.0	1.02	20.2	19.8	
	79	77x78	22.20	95.3	91.7	0.96	18.4	19.2	
13th	80	77x78	22.20	77.7	64.3	1.06	21.0	19.8	
(Jan 25,	81	81x79	21.22	96.7	94.7	0.96	18.8	19.6	
1978)	82	81x79	22.20	94 0	90.3	1 02	19 6	19.2	
	83	81x79	22.22	96.0	92.3	1.02	19 6	19.2	
	84	76x80	22.04	91.7	85.0	1.04	20.2	19.4	
Average			22.10	92.6	88.0	1.01	19 7	19 5	392
	72	78x77	20.20	94.3	90.9	1.22	26.2	21.5	
	73	78x77	20.04	92.0	86 9	1.25	25.8	20.6	
	74	78x77	20.22	90 9	83 7	1.17	23.6	20.2	
14th	75	78x77	19.22	90.3	81.7	1.26	26.4	21.0	
(June 18,	76	78x81	20 04	94.0	90.9	1.23	26.6	21.6	
1978)	77	78x81	20.04	88.3	86.0	1.26	26.6	21.1	
	78	78x81	20.22	92.3	86 9	1.25	25.4	20.3	
	79	77x81	21.04	95.7	88.6	1.29	27 0	20.9	
Average			20.13	92.2	87.0	1.24	26.0	20.9	398
	72	72x76	23.04	98 0	95.0	1.19	24.8	20.8	
	73	72x76	22.04	96.3	93.7	1.07	22.2	20 7	
	74	72x76	22.22	97.0	95.0	1.11	22.6	20.4	
15th	75	72x76	22.04	90 3	87.7	1.06	21 6	20.4	
(Aug. 15,	76	72x76	22.22	96 3	93 7	1.17	24.0	20.5	
1978)	77	79x73	22 22	92.7	88.7	1.17	23.2	19.8	
	78	79x73	22.22	92.3	89.0	1.20	25.0	20 8	
	79	79x73	22.22	93.0	86 0	1.18	24.0	20.3	
Average			22 18	94 5	91 1	1.14	23.4	20.5	469
	69	72x78	23.21	95.3	91.3	1.23	25.0	20 3	
	70	72x78	23.05	98.1	95.6	1.22	24.2	19.8	
	71	72x78	23.05	95 0	93 1	1 22	24.4	20.0	
16th	72	72x78	23.05	99.4	97.5	1.22	24.8	20.3	
(Oct. 15,	73	72x78	23.21	97.8	95.6	1.26	25.6	20.3	
1978)	74	79x76	23.21	95.0	91.6	1.26	25.8	20.5	
	75	79x76	23 05	95.9	93.1	1.20	24.2	20.2	
	76	79x76	23 05	96 3	94.1	1.17	23.8	20.3	
Average			23.11	96.6	94.0	1.22	24.7	20.2	486

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

CONCLUSION

Some good characters of K16 are high in viability, productivity and cocoon weight. The eggs per batch of K16 were much because of possible larger pupa in size. This is a good character to produce abundantly F_1 hybrid eggs in the sericultural practices. And another important character of K16 is to be easily reared with its high viability.

Viability of K18 was not so high as K16. Cocoons of K18 were smaller than K16, but productivity of K18 was higher than K16.

The egg producing ability of K18 has been different from last year, showing high production rather than K16. Though viability of K18 was not high as K16, hybrids mated by K18 showed similar results as those of K16 (3). A special character of K18 is a sex-limitted race It is very easy to visibly separate male and female in the larval stages. Consequently, if K18 will be used as a parent in producing F_1 hybrid, we shall steeply save time in the process of separating male and female for egg production.

K16 has been selected on 18 generations, while 16 generations of K18 have passed. The selection of K16 and K18 should be further carried on to find out better lineage for the parent races and resulting hybrids.

LITERATURE

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(2) PANNENGPET, P. and C. Pra-AIPAN. Survey on the practical characters of several hybrids of bivoltine silkworm races (8). (See 26)

26. Survey on the Practical Characters of Several F_1 Hybrids of Bivoltine Silkworm Races (8)

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 surveys (1), (2), (3), (4), (5), (6), (7).

MATERIALS AND METHODS

Surveying was done 4 times in 1978 on several F_1 hybrids as follows:

1st surveying	January 1978 on 14 F_1 hybrids
2nd surveying	June 1978 on 14 F_1 hybrids
3rd surveying	August 1978 on 15 F_1 hybrids
4th surveying	October 1978 on 16 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 last to 5th stage
2. Viability represented by cocooning ratio and sound pupa ratio which were calculated from the basic number of 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.

RESULTS

The results are shown in Tables 1 and 2.

K6xK16 was the best in the first survey of January, followed by K1xK18 and K6xK18 category. In June, the second survey, K6xK14 was better than K13xT and K6xK16. In August, the best among 15 hybrids was K6xK16, followed by K6xT and K6xK14. In the last survey, October, K13xK8 gave the best result, while K13xK16 and K13xK18 were in the second rank. Another F_1 hybrid which gave a slightly lower result was K13xE28.

DISCUSSION

In 1978, compared with the results of the previous year, the authors could find out several interesting combinations among the respective hybrids mated K13, K16, K18, E25 and E28 with K1, K6, K8, K14 and T. Fortunately, one of these races, K18, is a sex limitted one. By using this race as a parent in egg production programme, the amount of sex-discrimination work can be deducted, because we can separate simply the female with marking from the male at any time from the 4th instar immediately after molting. K13 is another race which its offspring gave a satisfactory result, especially, in the stoutness of hybrids. It may be expected that K13 could be promising in the near future.

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

Table 1. Comparison of practical characters of F_1 hybrids

Season	Hybrid	Term 1–5 stage	Cocoon-ing ratio	Sound pupa ratio	Whole cocoon weight	Cocoon shell weight	Cocoon shell ratio
		day	%	%	g	cg	%
January 1978	K1xT	22	97.3	93.7	1.04	19.0	18.3
	K6xT	23	96.3	96.3	1.19	22.4	18.8
	K13xT	22	96.7	95.0	1.11	20.4	18.4
	E25xT	22	95.0	93 7	1.10	19.8	18.0
	K1xK8	23	92.0	91.7	1.10	22.2	20.2
	K1xK14	24	97.0	96.0	1.20	24.4	20.3
	K1xK16	23	96.0	95.3	1.20	23.9	19.9
	K1xK18	23	99.0	98.3	1.17	23.5	20.1
	K6xK8	24	75.3	73.7	1.31	27.8	21.2
	K6xK14	24	97.7	95.3	1.40	30.5	21.8
	K6xK16	24	97.7	96.3	1.32	29.6	22.4
	K6xK18	23	97.0	96.3	1.24	26.1	21.0
	K6xE28	23	92.3	92.0	1.17	23.3	19.9
	E25xE28	23	96.0	95.3	1.14	22.2	19.5
June 1978	K1xT	21	95.0	94.7	1.30	23.5	18.1
	K6xT	22	97.0	95.7	1.60	29.4	18.4
	K13xT	20	100	98.3	1.28	23.2	18.1
	E25xT	20	99.3	90.0	1.35	23.6	17.5
	K1xK8	21	98.0	93.0	1.33	27.5	20.7
	K1xK14	22	98.0	91.3	1.49	27.9	18.7
	K1xK16	21	91.3	82.7	1.50	29.6	19.7
	K1xK18	21	100	96.0	1.44	28.9	20.1
	K1xE28	21	98.0	95.0	1.53	28.6	18.7
	K6xk8	22	97.3	91.3	1.62	34.9	21.5
	K6xK14	22	99.7	98.7	1.74	35.8	20.6
	K6xK16	22	97.0	91.3	1.70	35.4	20.8
	K6xK18	22	97.3	89.0	1.64	34.8	21.2
	E25xE28	21	99.0	88 3	1 48	27.5	18.6
August 1978	K1xT	21	94.7	93.7	1.33	25.4	19.1
	K6xT	22	97.0	95.7	1.64	31.0	18.9
	K13xT	21	92.7	89.7	1.42	27.0	19.0
	E25xT	21	97.0	96.3	1.41	25.8	18.3
	K1xK8	22	99.7	97.0	1.46	28.4	19.4
	K1xK14	22	97.7	97.0	1.49	29.2	19.6
	K1xK16	22	96.3	94.7	1.46	28 2	19.3
	K1xK18	21	87.7	73.3	1.31	27.0	20 6
	E28xK1	19	93.3	89.7	1.40	28.2	20.1
	K6xK8	22	95.3	94.3	1.47	31.8	21.6
	K6xK14	22	95.3	93.0	1.54	32.0	20.8
	K6xK16	23	96.7	96.3	1.56	32.6	20.9
	K6xK18	22	96.3	94.3	1.49	30.6	20.5
	E28xK6	22	97.0	95.0	1.46	29.2	20.0
	E25xE28	21	95.7	93.3	1.47	29.0	19.7
October 1978	K1xT	22	98 7	98.0	1.46	25 6	17.5
	E10xT	22	95.3	94.7	1.52	26.6	17.5
	N2xT	23	91.3	89.0	1.61	31.0	19.2
	K13xK8	23	99.0	98.3	1.68	35.8	21.3
	K13xK16	23	99.3	98.3	1 68	34.6	20.6
	K13xK18	23	98.3	98.0	1.66	34.8	21.0
	K13xE28	23	98.3	97.0	1.75	35.2	20.1
	E25xK8	23	99.7	98.7	1.48	29.6	20.0
	E25xK16	23	96 0	96.0	1.52	30 4	20.0
	E25xK18	23	96.7	96.0	1.63	32.8	20.1
	E28xE25	23	99.0	98.7	1.57	30.6	19.5
	E10xE22	23	98 7	98.3	1.63	31.6	19.4
	N2xK8	23	93.3	91.0	1.67	35.4	21.2
	N2xC2	24	96.7	92 7	1 59	36 6	23.0
	C2xN2	24	93.7	86.7	1.66	36 6	22.0
	Kinshu x Showa	24	98.0	94.7	1.77	39.8	22.5

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

Season	Temperature, °C			Relative humidity %
	Maximum	Minimum	Average	
January 1978	36.0	20.5	28.0	73
June	34.0	25.0	29.1	72
August	36.0	24.0	29.4	69
October	32.0	21.0	26.8	73

27. Survey on the Practical Characters of Several F_2 Hybrids of Bivoltine Silkworm Races (8)

Parn PANNENGPET and Charuk PRA-AIPAN

Successively, in order to confirm 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 were pursued to find out the best combination of F_2 hybrids (1), (2), (3), (4), (5), (6), (7).

MATERIALS AND METHODS

Survey was done 2 times in 1978 on several F_2 hybrids as follows:

1st surveying January 1978 on 3 F_2 hybrids
2nd surveying June 1978 on 3 F_2 hybrids

In each survey, young silkworms from several batches of each hybrid 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 hybrid.

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

RESULTS

The results are shown in Tables 1 and 2.

On the first and second surveying, performed in January and June respectively, $(K1xT)_2$ always showed the best results.

DISCUSSION

In 1978, it proved that $(K1xT)_2$ was suitable for the program of F_2 eggs distribution, if this program could be continued. The other 2 combinations, although their cocoon qualities were better than $(K1xT)_2$, showed inferior results, especially in larval stoutness.

LITERATURE

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

Table 1. Comparison of practical characters of F_2 hybrids

Season	hybrid	Term 1–5 stage	Cocoon-ing ratio	Sound pupa ratio	Whole cocoon weight	Cocoon shell weight	Cocoon shell weight
		day	%	%	g	cg	%
January	$(K1\times T)_2$	22	95.7	94.0	1.00	17.2	17.2
1978	$(K1\times K18)_2$	23	93.0	91.7	1.05	20.7	19.7
	$(K6\times K16)_2$	23	93.0	90 0	1.17	23.8	20.8
June	$(K1\times T)_2$	21	96.3	92.7	1.28	21.9	17.1
1978	$(K1\times K18)_2$	22	97 0	90.0	1.35	25.9	19.2
	$(K6\times K16)_2$	21	91.9	87.4	1.46	28.3	19.4

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

Season	Temperature °C			Relative humidity %
	Maximum	Minimum	Average	
January 1978	36.0	20.5	28.0	73
June 1978	34.0	25.0	29.1	72

28. Survey on the Practical Characters of Several Double Cross Hybrids of Bivoltine Silkworm Races (6)

Parn PANNENGPET and Charuk PRA-AIPAN

Double cross hybrid is a practical kind of hybrids in the sericultural practice. This kind of hybrid, if a suitable pair of F_1 hybrid to be combined is raised, would be hopeful to produce the similar cocoons as those of F_1 hybrid, 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 silkworm rearing, and higher in both percentage of moth emergence and in reproductivity of eggs per moth than parents of F_1 hybrids (1), (2), (3), (4), (5).

MATERIALS AND METHODS

Surveying was done 2 times in 1978 with several double cross hybrids as followes:

1st surveying January 1978 on 16 combinations
2nd surveying June 1978 on 15 combinations

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

Principal items to be surveyed or observed for judging the practical value 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 first survey, the best combination among 16 double cross hybrids was (K8.T)x(K6.K1), followed by (K6.T)x(K1.K18) and (K8 K14)x(K1.K4). In the second survey, in June, (K1.T)x(K6.K18) was the best combination, followed by (K6.T)x(K1.K16) and (K14.T)x(K6.K1).

DISCUSSION

Results of surveying, carried out two times in 1978, were not enough for judging the practical values of the hybrids. But an information from the results in 1978 is that the practical characters of present double cross hybrids are not so good as typical F_1 hybrids in both stoutness of larvae and cocoon qualities. Further trials with double cross hybrids will be pursued.

LITERATURE

(1) PANNENGPET, P.: Survey on the practical characters of three-way cross and double cross hybrid of bivoltine silkworm races. Bul. Thai Seri. Res. and Train. Centre, No. 3, 1973.
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(6) PANNENGPET, P., P. PIMPRAPAPORN and C. PRA-AIPAN: Ditto (5). Ibid. No. 8, 1978.

Table 1. Comparison of practical characters of double cross hybrids

Season	Hybrid	Term 1–5 stage	Cocooning ratio	Sound pupa ratio	Whole cocoon weight	Cocoon shell weight	Cocoon shell ratio
		day	%	%	g	cg	%
January 1978	(K1.T)x(K1.K8)	23	91.0	89.0	1.00	18.2	18.2
	(K1.T)x(K1.K14)	23	97.0	96.3	1.01	18.2	18.0
	(K1.T)x(K1.K18)	23	98.3	96.7	1.08	20.1	18.6
	(K1.T)x(K6.K8)	23	96.0	96.0	1.08	21.2	19.6
	(K1.T)x(K6.K16)	23	96.3	96.3	1.13	21.3	18.8
	(K6.T)x(K1.K8)	23	95.3	94.3	1.15	21.8	19.0
	(K6.T)x(K1.K14)	23	95.7	94.7	1.18	22.5	19.1
	(K6 T)x(K1.K18)	23	98.3	97.3	1.15	22.0	19 1
	(K6.T)x(K6.K8)	23	96.3	95.7	1.14	21.1	18.5
	(K6.T)x(K6.K16)	23	95.0	93.3	1.15	22.4	19.5
	(K8.T)x(K1.K4)	23	95.3	95.3	1.14	21.3	18.7
	(K8.T)x(K6.K1)	23	98.0	98.0	1.26	24.5	19.4
	(K8.K14)x(K1.K4)	24	95.7	95.3	1.19	23.6	19.8
	(K8.K14)x(K6.K1)	24	92.0	89.0	1.24	25.5	20.6
	(K16.T)x(K1.K4)	23	93.3	91.3	1.11	20.5	18.5
	(K16.T)x(K6.K1)	23	93.0	92.0	1.22	24.0	19 7
June 1979	(K1.T)x(K1.K14)	21	93.3	88.3	1.38	24.4	17.7
	(K1.T)x(K6.K16)	21	96.3	90.7	1.51	28.4	18.8
	(K1.T)x(K6.K18)	21	94.7	92.7	1.49	28.7	19.3
	(K6.T)x(K1.K14)	21	98.0	94.0	1.52	28.1	18.5
	(K6.T)x(K1.K16)	21	98.3	93.3	1.54	28.5	18.5
	(K6.T)x(K1.K18)	21	92.7	84.3	1.53	28.7	18.8
	(K8.T)x(K6.K1)	21	99.3	89.0	1.53	28.9	18.9
	(K8.T)x(K1.K4)	21	96.7	94.7	1.45	25.3	17.4
	(K8.T)x(K6.K4)	21	96.0	87.7	1.50	27.9	18.6
	(K14.T)x(K6.K1)	21	94.3	89.3	1.56	29.5	18.9
	(K14.T)x(K1.K4)	21	94.3	90.7	1.47	25.9	17.6
	(K14.T)x(K6.K4)	21	95.7	84.0	1.53	27.8	18.2
	(K16.T)x(K6.K1)	21	93.3	84.0	1.58	29.0	18.4
	(K16.T)x(K1.K4)	21	94.0	90.7	1.40	24.6	17.6
	(K16.T)x(K6.K4)	21	97.7	89.3	1.57	29.1	18.5

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

Season	Temperature °C			Relative humidity %
	Maximum	Minimum	Average	
January 1978	36.0	20.5	28.0	73
June 1978	34.0	25.0	29.1	72

29. Survey on the Period of Laval and Pupal Stages of the Main Silkworm Races in the Centre (5)

Peerapong CHAOSATTAKUL, Kanung BUACHOOM and Dara HARNKITCHANURAK

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 stages 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, K14, T	January 1978
K1, K8, K14, T, K18	June 1978
K1, K8, K14, T, K18	August 1978
K1, K8, K14, T, K18	October 1978

Furthermore, the practical combinations of crossing for F_1 hybrid by these parent races are K1xK8 (or K8xK1), K1xK14 (or K14xK1), K1xT (or TxK1), and K1xK18 (or K18xK1).

RESULTS AND CONCLUSION

The results obtained are shown in Tables 1 – 5 and summarized as follows:

1. The varietal defferences between K1 (a Japanese race) and some Chinese races, such as K8, K14, T, and K18, were 1 – 4 days in the total period of larval and pupal stages, in compliance with the rearing season.

2. In the case of K8 and K14 or K18 races, there was 1 – 2 days' difference between the total period of the larval and pupal stages of them.

3. The varietal difference between K1 and K8, K14 or K18 was 1 – 2 days in the total period of the larval and pupal stages by season.

4. The varietal difference between K1 and T was 1 – 4 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".

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Table 1. Period of larval stage (1) (1978)

Race		K1			
Season		January	June	August	October
Stage 1		d . h	d . h	d . h	d h
	Feeding term	3 . 20	2 . 20	2 . 20	3 . 06
	Sleeping term	1 . 00	1 00	1 . 00	0 19
	Total	4 . 20	3 . 20	3 . 20	4 01
	Temp. (°C)	25 6	29.4	27.7	27.5
	Hum. (%)	66	67	70	69
2	Feeding term	2 10	2 . 11	2 . 05	2 . 00
	Sleeping term	1 00	1 . 00	1 00	1 . 00
	Total	3 . 10	3 . 11	3 . 05	3 00
	Temp. (°C)	28.0	29.4	28.6	28.1
	Hum. (%)	73	64	75	74
3	Feeding term	3 . 00	3 . 00	2 . 05	3 00
	Sleeping term	1 . 00	1 . 00	1 . 00	1 . 00
	Total	4 00	4 . 00	3 . 05	4 . 00
	Temp. (°C)	26.5	29.2	29.0	27.9
	Hum. (%)	70	68	72	78
4	Feeding term	3 . 14	4 . 00	3 . 00	3 . 05
	Sleeping term	1 05	1 . 14	1 . 14	2 . 00
	Total	4 . 19	5 . 14	4 14	5 . 05
	Temp. (°C)	28.5	29.2	28.5	25.7
	Hum. (%)	64	68	72	73
5	Feeding term	5 22	6 . 08	6 . 00	6 23
	Sleeping term	–	–	–	–
	Total	5 . 22	6 . 08	6 . 00	6 23
	Temp. (°C)	29.5	27.8	30.3	25.4
	Hum (%)	66	75	76	79
Total stage	Feeding term	18 18	18 . 15	16 . 06	18 . 10
	Sleeping term	4 . 05	4 . 14	4 . 14	4 19
	Total	22 . 23	23 . 05	20 . 20	23 . 05
	Temp. (°C)	27.6	29 1	28.8	26.9
	Hum. (%)	68	68	75	75

Table 2. Period of larval stage (2) (1978)

	Race	K8				K14			
	Season	January	June	August	October	January	June	August	October
Stage 1		d h	d h	d h	d h	d h	d h	d h	d h
	Feeding term	3 20	3 07	2 20	3 01	3 01	3 01	3 01	3 01
	Sleeping term	1 00	1 18	1 00	1 00	2 00	1 05	1 00	1 05
	Total	4 20	5 01	3 20	4 01	5 01	4 06	4 01	4 06
	Temp. (°C)	24.3	29.7	27.1	27.6	24.4	30.5	27.8	27.4
	Hum. (%)	64	66	81	71	64	70	82	74
2	Feeding term	2 10	2 19	1 10	2 00	3 00	2 19	2 05	2 14
	Sleeping term	1 00	1 00	1 14	1 00	1 00	1 00	1 04	1 05
	Total	3 10	3 19	3 00	3 00	4 00	3 19	3 09	3 19
	Temp (°C)	28.3	29.3	28.3	28 1	28.0	29 8	29.7	28.2
	Hum. (%)	71	66	86	74	71	68	68	75
3	Feeding term	3 14	3 05	2 10	2 05	3 19	3 05	2 20	2 05
	Sleeping term	1 00	1 06	1 00	1 00	1 00	1 00	1 00	1 00
	Total	4 14	4 11	3 10	3 05	4 19	4 05	3 20	3 05
	Temp. (°C)	26.5	29.1	28.9	27.7	25.8	29.8	29.4	28.7
	Hum. (%)	73	65	73	78	71	67	66	78
4	Feeding term	3 10	4 00	3 00	3 00	3 10	4 00	3 19	4 00
	Sleeping term	1 14	1 13	1 14	2 00	1 14	1 14	1 19	1 19
	Total	5 00	5 13	4 14	5 00	5 00	5 14	5 14	5 19
	Temp. (°C)	28.1	29.1	28.4	25.7	28.8	30.0	30 0	24.7
	Hum. (%)	65	68	73	66	61	64	62	66
5	Feeding term	6 09	6 08	6 05	6 19	7 05	7 00	6 08	7 00
	Sleeping term	–	–	–	–	–	–	–	–
	Total	6 09	6 08	6 05	6 19	7 05	7 00	6 08	7 00
	Temp (°C)	29 3	27.8	28.9	25.4	28.0	27.8	29.0	26.3
	Hum (%)	67	75	73	79	60	77	69	79
Total stage	Feeding term	19 15	19 15	15 21	17 01	21 11	20 01	18 05	19 01
	Sleeping term	4 14	5 13	5 04	5 00	4 14	4 19	4 23	5 05
	Total	24 05	25 04	21 01	22 01	26 01	24 20	23 04	24 06
	Temp. (°C)	27.3	29.0	28 3	26 9	27.0	29.6	28.8	27.6
	Hum. (%)	68	68	75	75	65	69	75	74

Table 3. Period of larval stage (3) (1978)

	Race	T				K18		
	Season	January	June	August	October	June	August	October
Stage 1		d . h	d . h	d . h	d . h	d . h	d . h	d . h
	Feeding term	4 . 01	3 . 01	3 . 01	2 . 20	3 . 01	3 . 01	3 . 01
	Sleeping term	1 00	1 . 14	1 . 00	1 . 00	1 . 05	1 . 00	1 . 05
	Total	5 . 01	4 . 15	4 . 01	3 . 20	4 . 06	4 . 01	4 . 06
	Temp. (°C)	25.7	29.2	27.7	27.3	30.5	27 8	27 4
	Hum. (%)	66	68	82	74	70	82	74
2	Feeding term	2 . 05	2 . 10	2 . 19	2 . 05	2 . 19	2 . 05	2 . 19
	Sleeping term	1 . 00	1 . 00	0 . 10	1 . 00	I . 03	1 04	1 . 00
	Total	3 . 05	3 . 10	3 . 05	3 . 05	3 . 22	3 . 09	3 . 19
	Temp. (°C)	28.5	29.3	29.5	27.3	29 8	29.7	28.2
	Hum. (%)	72	65	74	79	68	68	75
3	Feeding term	3 . 00	3 . 00	2 . 00	2 . 19	3 . 02	2 20	2 . 05
	Sleeping term	1 . 00	1 . 00	1 . 00	1 . 00	1 . 00	1 . 04	1 . 14
	Total	4 . 00	4 . 00	3 00	3 . 19	4 . 02	4 . 00	3 . 19
	Temp (°C)	25.6	29.7	28.4	27.6	29.8	29.4	28.7
	Hum. (%)	70	63	74	79	67	66	78
4	Feeding term	3 . 14	4 . 00	3 . 14	3 . 10	4 . 00	3 . 15	3 . 10
	Sleeping term	1 . 05	1 . 14	1 . 00	1 . 14	1 . 14	1 . 19	2 . 00
	Total	4 . 19	5 . 14	4 . 14	5 . 00	5 . 14	5 . 10	5 . 10
	Temp. (°C)	28.5	28 8	28 7	24.1	30.0	30.0	24 7
	Hum. (%)	64	72	71	73	64	62	66
5	Feeding term	5 . 22	5 . 08	5 . 00	6 05	6 . 10	6 . 06	6 . 22
	Sleeping term	–	–	–	–	–	–	–
	Total	5 . 22	5 . 08	5 . 00	6 . 05	6 . 10	6 . 06	6 . 22
	Temp. (°C)	29.5	27.9	28.7	25.3	27.8	29.0	26 3
	Hum. (%)	66	74	75	82	77	69	79
Total stage	Feeding term	18 . 18	17 . 19	16 . 10	17 . 11	19 . 08	17 . 23	18 . 09
	Sleeping term	4 . 05	5 . 04	3 . 10	4 . 14	4 . 22	5 . 03	5 . 19
	Total	22 . 23	22 23	19 . 20	22 . 01	24 . 06	23 02	24 . 04
	Temp. (°C)	27.7	29.0	28.6	26.3	29 6	28.8	27.0
	Hum. (%)	68	68	75	77	69	75	74

Table 4. Period of pupal stage (1978)

	Race	K1				K8			
	Season	January	June	August	October	January	June	August	October
Pupal stage	Date of mount	Feb 16	July 9	Sept. 5	Nov 7	Feb 16	July 8	Sept. 4	Nov. 7
	Date of emerg	Mar 3	July 22	Sept. 18	Nov 22	Mar. 3	July 21	Sept. 17	Nov. 21
		d . h	d h	d . h	d . h	d . h	d . h	d . h	d . h
	Term	14 . 17	12 23	12 . 23	14 . 23	14 . 23	12 . 23	12 . 23	13 . 23
	Temp (°C)	27.6	28.4	28.7	25.8	27.4	28 4	28.7	25.5
	Hum (%)	68	76	73	78	72	75	73	77

	Race	K14				T			
	Season	January	June	August	October	January	June	August	October
Pupal stage	Date of mount.	Feb. 17	July 9	Sept. 7	Nov 10	Feb. 14	July 8	Sept. 5	Nov. 8
	Date of emerg.	Mar. 2	July 21	Sept. 20	Nov 24	Feb. 27	July 20	Sept. 17	Nov. 20
		d . h	d . h	d . h	d h	d h	d . h	d . h	d . h
	Term	13 . 03	12 . 02	12 . 14	13 21	12 . 23	11 . 23	11 . 23	11 . 23
	Temp (°C)	26.2	29.9	29.4	26.4	28.5	28.4	28.7	25.3
	Hum. (%)	59	69	68	67	71	76	73	77

	Race	K18		
	Season	June	August	October
Pupal stage	Date of mount.	July 8	Sept. 7	Nov. 10
	Date of emerg.	July 21	Sept. 20	Nov. 24
		d . h	d . h	d . h
	Term	12 . 16	12 . 22	13 . 21
	Temp. (°C)	29.9	29.4	27.4
	Hum. (%)	72	66	70

Table 5. Period from "HAKITATE" to moth emergence (1978)

Race	K1				K8			
season	January	June	August	October	January	June	August	October
	d . h	d h	d . h	d h	d . h	d . h	d . h	d h
Period of larval stage	22 . 23	23 . 05	20 . 20	23 05	24 . 05	25 . 04	21 01	22 01
Period of pupal stage	14 . 17	12 . 23	12 . 23	14 . 23	14 . 23	12 . 23	12 23	13 . 23
From "HAKITATE" to moth emergence	37 . 16	36 . 04	33 19	38 . 04	39 . 04	38 . 03	34 . 00	36 00

Race	K14				T			
Season	January	June	August	October	January	June	August	October
	d . h	d . h	d h	d . h	d . h	d . h	d . h	d . h
Period of larval stage	26 01	24 20	23 . 04	24 . 06	22 . 23	22 . 23	19 . 20	22 . 01
Period of pupal stage	13 . 03	12 . 02	12 . 14	13 . 21	12 . 23	11 . 23	11 . 23	11 . 23
From "HAKITATE" to moth emergence	39 . 04	36 . 22	35 . 18	38 . 03	35 . 22	34 . 22	31 . 19	34 . 00

Race	K18		
Season	June	August	October
	d . h	d . h	d . h
Period of larval stage	24 . 06	23 . 02	24 . 04
Period of pupal stage	12 16	12 . 22	13 . 21
From "HAKITATE" to moth emergence	36 . 22	36 . 00	38 . 01

30. Survey on the Amount of Food for the Main Silkworm Races in the Centre (5)

Peerapong CHAOSTTAKUL, Dara HARNKITCHANURAK and
Dowruang CHAOSATTAKUL

In order to make a plan of silkworm 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 four years (1), (2), (3), and (4) 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, K14, K18 and T

2. Rearing season
   K1, K8, K14, and T . January, June, August and October, 1978
   K18 (a new strain) : June, August, and October, 1978

3. Number of batches reared . Number of batches reared ranged 10 to 40 by season and race.

RESULT AND CONCLUSION

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

There was found the same tendency that PECHMONT (1), CHOMCHUEN and CHAOSTTAKUL (2), and TENGRATANAPRASERT, HARNKITCHANURUK and NOI-SOMBAT (3) 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 difference in the younger stage.

From the data, it may be summarized that the minimum of mulberry leaves per batch of silkworms required to their total larval stage is 10.7 kg for K1, 11.0 kg for K8, K14 and K18, respectively, in spite of 10 0 kg for T, with the tendency to be the same as in the previous years.

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Table 1. Amount of leaves supplies (1) (1978)

Race		K1				K8			
Stage	HAKITATE	January	June	August	October	January	June	August	October
	Batches reared	30	40	30	20	20	40	40	40
1	Food/batch (g)	52.8	39.0	33.0	39.8	35.7	35.6	32.5	38 8
	Temp. av. (°C)	25.6	29.4	27.7	27.5	24.3	29.7	27.1	27.6
	Hem. av. (%)	66	67	79	69	71	66	81	71
2	Food/batch (g)	125	90.9	91.3	112.0	91.2	82.4	70.5	107.0
	Temp. av. (°C)	28.0	29.4	28.6	28.1	28.3	29.3	28.3	28 1
	Hum. av. (%)	73	64	75	74	71	66	76	74
3	Food/batch (g)	349	291.8	276.3	402.5	272.2	258.8	266.0	381.5
	Temp. av. (°C)	26 5	29.7	28.5	27.9	26.5	29.1	28.9	27.7
	Hum. av. (%)	70	64	72	78	73	65	73	78
4	Food/batch (kg)	1.9	1.8	2.2	2.2	2.0	2.0	1.6	1.8
	Temp. av. (°C)	28.5	29.2	29.0	25.7	28.1	29.1	28.4	25 7
	Hum. av. (%)	64	68	72	73	65	68	73	73
5	Food/batch (kg)	7	6.7	9.0	9.9	8.1	8.4	8.8	9.7
	Temp. av. (°C)	29.5	27.8	30.3	25.4	29.3	27.8	28.9	25.4
	Hum. av. (%)	66	75	76	79	67	75	73	79
Total	Food/batch (kg)	9.4	8.9	11.6	12.7	10.5	10.8	10.8	12.0
	Average (kg)	10.7				11.0			
	Temp. av. (°C)	27.6	29.1	28.8	26.9	27.3	29.0	28.3	26.9
	Hum. av. (%)	68	68	75	75	69	68	75	75

Table 2. Amount of leaves supplied (2) (1978)

Race		K14				T			
Stage	HAKITATE	January	June	August	October	January	June	August	October
	Batches reared	40	40	10	10	20	10	10	10
1	Food/batch (g)	35.1	26.0	37.5	48.5	37.3	42.5	38.5	41.0
	Temp. av. (°C)	24.4	30.5	27.8	27.4	25.7	29.2	27.7	27.3
	Hum. av. (%)	64	70	82	74	66	68	82	74
2	Food/batch (g)	69.8	68.0	86.5	95.1	105.5	100.0	99.0	142.0
	Temp. av. (°C)	28.0	29.8	29.7	28.2	28.5	29.3	29.6	27.3
	Hum. av. (%)	71	68	68	75	72	65	71	79
3	Food/batch (g)	229.3	267.1	314.5	578.5	297.0	246 0	299.0	347.0
	Temp. av. (°C)	25 8	29.8	29.4	28.7	26.5	29.7	28.4	27.6
	Hum. av. (%)	71	67	66	78	70	63	74	79
4	Food/batch (kg)	1.4	2.0	1.8	1.8	1 8	2.1	2.0	2 0
	Temp. av. (°C)	28.8	30.0	30.0	24.7	28.5	28.8	28.7	24.1
	Hum. av (%)	61	64	62	66	64	72	71	73
5	Food/batch (kg)	8.3	8.2	7 8	10.0	6.8	8.1	7.3	8.7
	Temp. av (°C)	28 0	27.8	29.0	26.3	29.5	27.9	28.7	25.3
	Hum av. (%)	60	77	69	79	66	74	75	82
	Food/batch (kg)	10.0	10.6	10.0	12.5	9.0	10.6	9.7	11.2
Total	Average (kg)	10 8				10.1			
	Temp. av. (°C)	27.0	29.6	29.0	27.0	27.7	29.0	28.6	26.3
	Hum. av. (%)	65	69	69	74	68	68	75	77

Table 3. Amount of leaves supplied (3) (1978)

Race		K18		
Stage	HAKITATE	June	August	October
	Batches reared	10	40	40
1	Food/batch (g)	35.0	34.4	32.0
	Temp. av. (°C)	30.5	27.8	27.4
	Hum av (%)	70	82	74
2	Food/batch (g)	92.5	61.3	103 5
	Temp. av. (°C)	29.8	29.7	28.2
	Hum av. (%)	68	68	75
3	Food/batch (g)	513.5	276.8	346.1
	Temp. av. (°C)	29.8	29.4	28.7
	Hum. av. (%)	67	66	78
4	Food/batch (kg)	1 7	1.7	1.6
	Temp. av (°C)	30	30	24.7
	Hum av. (%)	64	62	66
5	Food/batch (kg)	8 4	7.7	10.3
	Temp. av. (°C)	27.8	29.0	26.3
	Hum. av. (%)	77	69	79
Total	Food/batch (kg)	10.7	9.8	12.4
	Average (kg)	11.0		
	Temp. av. (°C)	29.6	29.2	27.0
	Hum. av. (%)	69	69	74

31. The Effects of Hydrochlorization and Differently Refrigerated Term on Hatchability of Silkworm Eggs Shortly after being Laid (3)

Perrapong CHAOSATTAKUL and Masashi RACHI

In the previous experiments (1), (2) and (4), we reported already the effects of the cold storing term on artificial hatching of silkworm eggs shortly after being laid. However, these data were obtained by the HCl-treatment as usual, using some Japanese silkworm hybrids and by the improved HCl-treatment, using our hybrids.

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, using the present popular hybrids and a new one bred in this Centre.

MATERIALS AND METHODS

1.	Time of experiment	:	22 July, 1978 – 17 January, 1979
2.	Variety of silkworm used	:	K1xK8, K8xK1, K1xK18, and K18xK1
3.	Date of eggs laid	:	22 July, 1978 and 22 November, 1978
4.	Number of eggs used	:	(8 batches x 4) x 4 = 128 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, 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. However, as for the new hybrid, K1xK18, another experiment is to be carried on.

LITERATURE

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(3) CHOMCHUEN, V. and P. CHAOSATTAKUL: The effects of hydrochlorization and differently refrigerated term on hatchability of silkworm eggs shortly after being laid (1) Ibid. No. 6, 1976.
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Table 1. Hatchability on artificial hatching of silkworm eggs shortly after being laid (July, 1978)

Variety	Term of cold storing (days)	Daily percentage of hatched eggs (%)					
		1st	2nd	3rd	4th	Total	Successive highest two days
K1xK8	0	85.6	9.0	0.5	0.1	95.2	94.6
	20	34.5	57.7	2.5	0.4	95.1	92.2
	30	90.5	3.4	1.2	0.7	95.8	93.9
	40	64.0	8.8	11.8	1.2	85.8	72.8
K8xK1	0	88.4	7.6	0.7	0	96.7	96.0
	20	13.9	75.9	5.9	0.3	96.1	89.8
	30	80.4	10 8	2.4	1.2	94.8	91.2
	40	76.2	3.8	8.8	0.8	89.5	79.9

Table 2. Hatchability on artificial hatching of silkworm eggs shortly after being laid (November, 1978)

Variety	Term of cold storing (days)	Daily percentage of hatched eggs (%)					
		1st	2nd	3rd	4th	Total	Successive highest two days
K1xK8	0	25.3	59.1	8.5	–	92.9	84.4
	20	62.2	21.7	5.1	0.6	89.6	83.9
	30	44.9	17.9	4 0	0.5	67.3	62.8
	40	61.4	13.3	2 6	–	77.3	74.7
K1xK18	0	21.6	68.7	7.0	–	97.3	90.3
	20	66.7	20.0	4 6	0.6	91.9	86.7
	30	49.8	17.4	9.1	1.1	77.4	67.2
	40	58 6	8.4	2.1	–	69.1	67.0
K18xK1	0	42.3	48.8	2.3	–	93.4	91.1
	20	52.8	14.2	4.1	0.1	71.2	67.0
	30	58.3	11.0	1.7	0.2	71.2	69.3
	40	51.2	5.4	0.6	–	57.2	56.6

32. Effects of Different Cold Storing Term of Silkworm Eggs on Their Hatchabilities in the Acid-treatment after Chilling Method (2)

Peerapong CHAOSATTAKUL and Masashi RACHI

The previous experiments (1), (2), (3) 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 HCl. 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.

Accordingly, the present experiment was performed to confirm the effects of the different refrigerating term of silkworm eggs on their hatchabilities in the standard acid treatment after chilling, using one of the most available silkworm varieties and a new one for the practical process of sericulture in the tropics.

MATERIALS AND METHODS

1.	Time of experiment	:	21 Sept., 1978 – 17 Feb., 1979
2.	Variety of silkworm	:	K1xK8, K8xK1, K1xK18 and K18xK1
3.	Date of eggs laid	:	21 Sept., 1978 and 22 Nov., 1978
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	:	50, 60, and 70 days
8.	Number of eggs used	:	(8 batches x 3) x (4+3) = 168 batches
9.	Temperature and specific gravity of HCl 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 50 – 70 days produced considerable hatching ratios in the cases of a new hybrid (K1xK18 and its reciprocal, K18xK1) as well as K1xK8 or K8xK1.

Needless to say, it is one of the most important matters to set the adequate storing period 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.

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(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.

Table 1. Hatchability of cold stored silkworm eggs (Sept., 1978)

Race	Term of cold storing (days)	Daily percentage of hatched eggs (%)					
		1st	2nd	3rd	4th	Total	Successive highest two days
K1×K8	50	6.7	51.3	31.3	3.2	92.5	82.6
	60	6.9	41.2	29.1	11.3	88.5	70.3
	70	23.4	53.7	12.5	0.8	90.4	77.1
K8×K1	50	65.1	30.7	0.4	0.1	96.3	95.8
	60	1.3	37.7	49.0	8.6	96.6	86.7
	70	85.4	11.2	0 4	0.3	97.3	96.6
K1×K18	50	5.8	47 6	35.0	9.0	97.4	82.6
	60	28 8	49.7	18.3	0 4	97.2	78.5
	70	13.6	67.5	16.3	0.2	97 6	83 8
K18×K1	50	65.6	33.1	0.6	0	99.3	98.7
	60	45.3	53 3	0 2	0	98.8	98.6
	70	79.5	18 0	1 3	0.1	98 9	97.5

Table 2. Hatchability of cold-stored silkworm eggs (November, 1978)

Race	Term of cold storing (days)	Daily percentage of hatched eggs (%)					
		1st	2nd	3rd	4th	Total	Successive highest two days
K1xK8	50	22.2	60.6	7.4	0.3	90.5	82.8
	60	25.0	59.1	5.7	0.6	90.4	84.1
	70	28.4	65.0	2.7	0	96.1	93.4
K1xK18	50	6.4	71.8	19.5	0.4	98.1	91.3
	60	5 8	83.1	7.9	0.4	97.2	91.0
	70	14.3	76.1	6.7	0	97.1	90.4
K18xK1	50	12.0	76.7	9 6	0.4	98.7	88 7
	60	31.5	64.1	2.3	0 4	98.3	95.6
	70	42.1	57 1	0 4	0	99.6	99.2

33. Effects of Temperature Keeping Male Moths before Mating on Production of Non-fertilized Eggs

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

To raise the efficiency of silkworm egg production, it is one of the most important matters 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 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, followed by survey of survival period of male moths to be mated.

MATERIALS AND METHODS

1. Time of experiment : September 5 – 23, 1978

2. Race of silkworm : K1 (♂) and K8 (♀)

3 Date and station of eggs deposition : September 5, 1978 at 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 three mating times as mentioned below:

   1) 08:30 – 11:00
   2) 11.30 – 14:00
   3) 14:30 – 17:00

5. Number of moths used:

   K1 (♂) : 100 x 2 = 200
   K8 (♀) : (100x2) x 3 = 600
   Total : 800 heads

6. Treatments

   (1) Collected until 08.00 a.m., each 100 male moths each were placed into each moth collection box. Then, A group and B group were kept in rearing room (26° – 33°C) and in cold storage at 7°C, respectively.

   (2) Transferred to 6 rearing trays with 100 heads per tray until 08:30 a.m., 600 female moths to be crossed were grouped into two lots with three trays.

* Udorn Thani Sericultural Experiment Station

(3) Both A and B group had three mating times a day. And in B group, after the respective separation the male moths were preserved in to 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.

(5) Surveys on male moths, copulated three times, were continued to their survival periods for 20 days.

RESULTS AND CONCLUSION

Shown in Tables 1 and 2, 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 or the third 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 by 8 – 14% as compared with B group.

   3) The survival period of male moths which had been copulated three times was 17 days in A group, though in B group 64% of male moths survived for twenty days or more.

From the above results it must be considered 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.

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

Order of mating time	Card No.	Eggs of A-group				Eggs of B-group			
		Normal (%)	Non-fertilized (%)	Dead (%)	Total	Normal (%)	Non-fertilized (%)	Dead (%)	Total
1	1	92.8	6.3	0.9	100 0	93.6	3.0	3.4	100.0
	2	92.5	6.0	1.5	100.0	88.0	5.8	6.2	100.0
	3	88.1	5.2	6.7	100.0	87.7	6.6	5.7	100.0
	4	86.6	6.2	7.2	100.0	88.2	7.7	4.1	100.0
	av.	90.2	6.0	3.8	100.0	89 5	5.7	4.8	100.0
2	1	80 4	11.6	8.0	100.0	85 4	10.6	4.0	100.0
	2	68.9	23.4	7.7	100.0	88 5	8.2	3.3	100.0
	3	75.2	17.7	7.1	100 0	88.4	9.1	2.5	100.0
	4	79.3	12.5	8.2	100 0	86.4	8.5	5.1	100.0
	av.	75 4	17.0	7.6	100.0	87.1	9.1	3.8	100.0
3	1	55.8	33.1	11.1	100 0	66.2	13.8	20.0	100.0
	2	87.0	21.8	11.2	100 0	59.3	19 2	21.5	100.0
	3	66.3	26.8	6.9	100.0	87.2	8 4	4.4	100.0
	4	49.2	40 4	10.4	100.0	73 0	21 7	5.3	100.0
	av.	60.4	29.9	9.7	100.0	70 6	15.8	13.6	100.0

Table 2. Survival period of male moths, completed three times' mating

Order of day	Mortality (%)		Order of day	Mortality (%)	
	A-group	B-group		A-group	B-group
1	0	0	11	–	2 (2)
2	0	0	12	–	4 (6)
3	0	0	13	–	0
4	6 (6)	0	14	–	4 (10)
5	14 (20)	0	15	–	2 (12)
6	60 (80)	0	16	–	4 (16)
7	20 (100)	0	17	–	2 (18)
8	–	0	18	–	6 (24)
9	–	0	19	–	4 (28)
10	–	0	20	–	8 (36)

( ) : Shows % in total.

34. Experiment on the Time from Egg Deposition to Acid Treatment on Artificial Hatching (SOKUSIN)

Kanung BUACHOOM, Dara HARNKITCHANURUK, Peerapong CHAOSATTAKUL, Puchong PECHMONT, Kesorn SORNCHIT, Dowruang CHAOSATTAKUL and Songrak TENGRATANAPRASERT

The right time for conducting this common acid-treatment is about 15-20th hour after oviposition, preserved at 24 – 25°C.

Generally, moths, emerged from cocoons in the morning, are allowed to copulate for 3-4 hours, and seperated around noon. Many of moths lay eggs towards 6-8 p.m., most actively So, even if moths are allowed to lay eggs until the following morning, the time after oviposition is reckoned by the passage from 8 p.m.

Consequently, the 20th hour after oviposition roughly falls on 4 p.m. of the following day. So, we conduct the acid-treatment around this hour.

The development of embryo, having its own pecularity, varies with the preservation temperature during oviposition. It is safe to adjust the time of treatment.

This test was done to clear up the right time for conducting the common acid treatment in handling of silkworm eggs.

MATERIAL AND METHOD

1.	Date of experiment	:	I. July 21, – August 6, 1978 II. Nov. 21, – Dec. 5, 1978
2.	Silkworm strain	:	K1
3.	Number of eggs used	:	20 batches, laid on a sheet of paper, were separated in 80 pieces.
4.	Temperature of the room where the eggs had been kept before hydrochlorization	.	I. 27.4°C (25.5 – 29.6°C) II. 26.9°C (30.2 – 23.5°C)
5.	The time from egg deposition to hydrochlorization	:	15, 18, 19, and 20 hours.
6.	Hatchability, calculated from the successive highest 2 days.		
7.	The specific gravity of HCl, temperature of HCl, and duration in dipping	:	1.110 (at 15°C), 30°C, and 50 min.
8.	Type of test	:	Randomized Complete Blocks Design with four treatments – five replications.

RESULTS AND CONCLUSION

The results are shown in Tables 1 and 2.

There were differences between Ist and IInd experiments.

From the results, however, it may be concluded that the 18-20th hour after being laid was most suitable for the practical term from egg deposition to acid treatment, while 15 and 19th hour after being laid were fairly good.

LITERATURE

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Table 1. Analysis of variance

Date of exp. I. July – Aug. 1978
II. Nov. – Dec. 1978

SV.	d.f.	Date of exp.	Mean squares		
			Hatchability (%)		
			Successive highest 2 days	Others not including successive highest 2 days	No. hatching (%)
Replication		I	32.2641**	24.6192	2.1808^{ns}
		II	44.6200**	1.0965^{ns}	35.3871*
Treatment	3	I	20 5254**	.8 5964	3 4974*
		II	14.3305^{ns}	0.8246^{ns}	10.1857
Error	12	I	3.4271	2.0723	0.7383
		II	7.7953	0.2100	6.0276
CV %		I	2	24.2	44.7
		II	3.2	30.7	24.2

Table 2. Table of means

Date of exp. I. July – Aug 1978
II. Nov. – Dec. 1978

Treatment	Date of exp.	Hatchability (%)				No. hatching (%)	DMRT
		Successive highest 2 days	DMRT	Others not including successive highest 2 days	DMRT		
15 hrs after being laid	I	90 38	b	2.98	a	6.62	ab
	II	89.06	a	0 98	b	9.95	a
18 hrs. after being laid	I	93.59	a	1.47	b	4.92	a
	II	86.16	a	1.97	a	11.86	a
19 hrs. after being laid	I	90.37	b	2.15	ab	7.45	b
	II	88 10	a	1.56	ab	10.33	a
20 hrs after being laid	I	94.14	a	1.07	b	4.77	a
	II	90.15	a	1.45	ab	8.39	a

35. Experiment on the Relations between the Hatchability and the Length of Cold-stored Duration in the Artificially Hibernated Silkworm Eggs (4)

Dara HARNKITCHANURUK and Phuchong PECHMONT

In the last experiment (3) on the artificially wintered silkworm eggs, CHOMCHUEN, V., S. TENGRATANAPRASERT, P. PECHMONT, K. BUACHOOM and P. CHAOSATTAKUL had got the following results.

1. The suitable period of pre-storage at 25°C was 30 days for a cold storage within the range of 100 – 200 days, while in the case of 50 days beyond 30 days, no good result was obtained.

2. The suitable HAKITAKE-term for practical use of artificially hibernated silkworm eggs seemed to be in the time just after stored for 130 – 200 days at 5°C.

Using some popular silkworm races, the present experiment was repeatedly performed to test the hatchability to be caused by the relations between pre-stored period and duration of cold storage, especially putting stress on the case of cold stored duration, less than 130 days and more than 200 days. Because it is clear in the practice of sericulture that the expected data of "HAKITATE" in the artificially hibernated silkworm eggs is to be dependent upon their relations.

MATERIALS AND METHODS

1.	Time of experiment	:	Sep. 13, 1977 – June, 1978
2.	Silkworm variety	:	K1xT, K1xK14 and K1xK8
3.	Experimental design		Randomized complete block method; 36 treatments and 3 replications.
4.	Number of eggs used	:	3/3 batch x 36 (treatments x 3 rep. = 108 batches
5.	Method of artificial hibernating	:	Eggs were stored in a chamber at 5°C for 100, 130, 150, 180, 200 and 220 days after having been kept in a room at 25°C for 5, 15, 25, 30, 40 and 50 days. Each plot was kept for 6 – 12 hours at 15°C just before and after the storage in a cold chamber.

6. The percent of daily hatching was calculated, founded on counting daily the number of eggs hatched. In the table, however, only the hatched eggs in the successive highest two days were shown as the important matter to know the results.

RESULT AND CONCLUSION

The results obtained are shown in Tables 1 and 2. The relations between hatchability and length of cold-stored duration in the artificially hibernated silkworms eggs seemed to be summarized as follows:

		Period at 25°C after being laid (days)	Duration stored at 5°C (days)	Hatchability (%) (successive highest two days)
1)	K1xT	5	< 130	90.4
		15	130-200	89.4
		30	< 150	88.2
		25	150-200	86.0
		40	< 130	86.0
		50	130-200	82.2
2)	K1xK14	15	100-200	83.6
		5	100-200	82.5
		40	100-150, 200-220	80.9
		50	130-220	75.9
		25	100-220	75.1
		30	100-200	63.0
3)	K1xK8	5	130-200	84.1
		25	130-180	82.4
		15	100-200	82.0
		30	100-200	80.2
		40	130-220	64.0
		50	150-220	62.3

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Table 1. ANOV for hatchability

SV	df	Mean square					
		K1xT		K1xK14		K1xK8	
		Successive highest 2 days (hatched eggs)	Unhatched eggs	Successive highest 2 days (hatched eggs)	Unhatched eggs	Successive highest 2 days (hatched eggs)	unhatched eggs
Replication	2	51 2843	1.5180	32.5682	20.3437	314.6493	369.8204
Treatment	35	343 5971**	252.8713**	299.5857**	326.1289**	538.1841**	595.9701**
At 5°C (A)	(5)	1456.9074**	600.1950**	864.7749**	912.6253**	1085 0162**	686.3872**
At 25°C (B)	(5)	208.3784**	398.4211*	76.5619^{ns}	117.1545^{ns}	941.4732**	1246.0164**
AxB	(25)	147.9787	154.2966	231.1525**	250.6244**	348.1598**	447.8774**
Error	70	36.4952	45.5090	91.3291	99.1430	125.5110 (1	158.2577 (1
CV%		9.3	45.2	15.6	45 8	20.2	45.3

(1 : One missing plot

Table 2-1. Hatchability of successive highest two days (%), K1xT

DMRT, horizontal difference						
25°C \ 5°C	100 days	130 days	150 days	180 days	200 days	220 days
5 days	52 2 b	92.1 a	86.3 a	95.6 a	89.4 a	88.5 a
15 days	66.0 c	92 8 a	87.5 ab	88.0 ab	89.3 ab	79.3 bc
25 days	70 4 c	64.4 c	91.6 a	79.2 abc	86.8 ab	78.0 bc
30 days	59.6 b	66.9 b	85.1 a	88.4 a	86.7 a	92.4 a
40 days	52 5 b	89.0 a	87.8 a	87 1 a	77.0 a	86.5 a
50 days	16.0 c	79 8 ab	90.2 a	75.0 b	84.4 ab	81.4 ab

Table 2-2 K1xK8

DMRT, horizontal difference						
25°C \ 5°C	100 days	130 days	150 days	180 days	200 days	220 days
5 days	60.7 bc	95.5 a	79.2 ab	84.4 ab	77.2 ab	43.3 c
15 days	73.0 ab	93.5 a	77 6 a	84.4 a	81.3 a	44.2 b
25 days	33.2 b	74.5 a	90.6 a	82.0 a	17.3 b	31.8 b
30 days	78.5 ab	72.9 ab	90.4 a	82.9 ab	76.5 ab	58.2 b
40 days	39 6 b	60.5 ab	73.2 a	68.0 ab	50.3 ab	68 0 ab
50 days	32.8 b	35.6 b	52.4 ab	62.1 a	68.7 a	65.9 a

Table 2-3. K1xK14

DMRT, horizontal difference

25°C \ 5°C	100 days	130 days	150 days	180 days	200 days	220 days
5 days	81.6 a	85.9 a	89.6 a	81.6 a	75.3 a	37.2 b
15 days	77.6 a	93.6 a	89 3 a	85 8 a	71.9 a	36 0 b
25 days	75.5 a	74.8 a	75.8 a	74.1 a	84.2 a	66.0 a
30 days	78.0 ab	88.0 a	93.1 a	71.0 ab	74.7 ab	56 2 b
40 days	74.6 a	80.0 a	89.1 a	47.1 b	81.0 a	79.6 a
50 days	33.0 b	84.1 a	73.1 a	70.4 a	80.7 a	71.1 a

36. Experiment on Acid Treatment (Artificial Hatching) After Short Time Chilling, (a Preliminary Note)

Peerapong CHAOSATTAKUL, Dara HARNKITCHANURUK, Dowruang CHAOSATTAKUL and Phuchong PECHMONT

Generally, if acid-treated eggs (common acid-treatment) are to be cold-stored in 20 – 30 hours, after preserved at 25°C after treatment, the eggs can be cold-stored at 5°C for 20 – 30 days (1), but in case of acid treatment after chilling the usable cold-stored duration are 60 – 100 days. So that, if silkworm eggs to be reared could be requested by farmers between the duration of the former and the latter treatment, it follows that none of them are available.

Accordingly, this experiment was tried to find out the suitable short-term cold-storage to keep the acid-treated eggs under good condition.

MATERIAL AND METHODS

1.	Silkworm variety	:	K1xK14
2.	Number of silkworm eggs used	:	63 batches, separated in 21 pieces with 3 replications
3.	Form of experiment	:	4 x 5 factorial in R.C.B. + 1 check
4.	Number of treatment and replication	:	21 treatments and 3 replications
5.	Date of eggs laid	:	21 July, 1978 and 21 September, 1978
6.	Duration kept eggs at 25°C	:	25, 30, 35, 40 hours
7.	Temperature and specific gravity of HCl solution	:	35°C and 1.110 at 35°C
8.	Duration of hydrochlorization	:	40 minutes
9.	Condition of check	:	Duration at 25°C, 48 hours; duration at 5°C, 60 days; temperature and s.q., 35°C 1.110; duration of hydrochlorzation, 40 minutes
10.	Term of cold storing (5°C)	:	20, 25, 30, 35, 40 days

RESULTS AND CONSIDERATION

The results obtained are shown in Tables 1, 2, 3, 4, 5 and 6 and summarized in the following:

1st experiment: No significant difference was found out between check and treatments, while among the treatments the silkworm eggs, kept at 25°C for 25, 30, 35, and 40 hours after laid and then preserved at 5°C for 20 and 40 days, respectively, showed each hatchability of 90.36 – 90.28% in average to be highly significant.

2nd experiment: The hatching percentage of silkworm eggs, kept at 25°C – 25 hours and then kept at 5°C – 25-40 days was 95.23% in average, being highly significant to 5°C – 20 days, though non-significant with the check.

2. The hatching percentages of silkworm eggs, kept at 25°C – 30 hours and then kept at 5°C – 30-40 days, were averaged 95.85% with highly significance to 5°C – less then 30 days, though non-significant with the check.

3. The hatchabilities, kept at 25°C – 35 hours and then kept at 5°C – 30-40 days, were averaged 94.61% with highly significance to 5°C – less than 30 days, though non-significant with the check.

4. The hatchabilities, kept at 25°C – 40 hours and then kept at 5°C – 35-40 days, were averaged 96.54% with highly significance to 5°C – less than 35 days, though non-significant with the check.

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Table 1. ANOV of hatching percentage (1st experiment)

SV	df	MS	F
Replication	2	50.1697	1.95^{ns}
Treatment	20	63.1525	2.45**
Check VS treated	1	39 4533	1.53^{ns}
Among treated	19	64.3998	2.50**
5°C (A)	4	152.3103	5.92**
Linear	(1)	11.4022	<1
Quadratic	(1)	545.5086	21.19**
Cubic	(1)	52 0478	2.02^{ns}
Quartic	(1)	0.2827	<1
25°C (B)	3	114.2692	4.44**
Linear	(1)	56.7849	2.21^{ns}
Quadratic	(1)	41.8335	1.62^{ns}
Cubic	(1)	244.1894	9.40**
AxB	12	22.6289	<1
Error	40	25.7437	

C.V. = 5.8%

Table 2. Table of A-mean (1st experiment)

Treatment (5°C)	Mean (%)
20 days	90 36
25 days	83.38
30 days	83.02
35 days	86.63
40 days	90.28

LSD 0.05 for A-mean = 4.19
0.01 for A-mean = 5.60

Table 3. Table of check (mean, %)

25°C	5°C
	60 days
48 hours	90.45

Table 4. ANOV of hatching percentage, (2nd experiment)

SV	d f	MS	F
Replication	2	33.5987	<1
Treatment	20	1,606.9281	23.58**
Check VS treated	1	811.5281	11.91**
Among treated	19	1,648 7897	24.19**
5°C (A)	4	5,464.2995	80.17**
Linear	(1)	18,498.5984	271.40**
Quadratic	(1)	3,336.3498	48.95**
Cubic	(1)	0.0038	<1
Quartic	(1)	22.2463	<1
25°C (B)	3	1,602.5300	23.51**
Linear	(1)	4,395 0034	64.48
Quadratic	(1)	299.2667	4.39*
Cubic	(1)	113.3199	1.66^{ns}
AxB	12	388.5204	5.70**
AxB Linear	(4)	1,043.9297	15.32**
AxB Quadratic	(4)	54.5756	<1
AxB Cubic	(4)	67.0561	<1
Or			
A Linear x B	(3)	1,332.5632	19.55**
A Quadratic x B	(3)	37.4852	<1
A Cubic x B	(3)	159.0682	2.33^{ns}
A Quadratic x B	(3)	24.9652	<1
Error	38 (1	68.1594	

(1 Two missing data C.V. = 10.2%

Table 5. Table of AxB mean (%) (2nd experiment)

25°C (B)	5°C (A)				
	20 days	25 days	30 days	35 days	40 days
25 hours	63.87	91.86	96.94	96.01	96.01
30 hours	66.42	87 16	93.87	96.53	97.15
35 hours	37.09	63.50	90.92	96.59	96.31
40 hours	19.55	44.36	79.11	96.99	96.08

LSD 0.05 for AxB mean = 13.62
0.01 for AxB mean = 18.23

Table 6. Table of check (mean, %)

25°C	5°C
	60 days
48 hours	97.17

37. Effectiveness of Some Fungicides in Controlling Aspergillus Disease of Silkworm (2)

Laksanawadee ISARANGKUL, Thongchai SITTISONGCRAM,
Sukit THAMPRANEE and Takashi ISHIJIMA

Ceresan lime has been used widely and effectively in controlling *Aspergillus* and Muscardine diseases of silkworm in Thailand. In recent years, however, it has stopped to be used in the sericultural field of Japan, based on the following two major reasons; possible harmful effects to human beings due to its active ingredient "organic mercury", and relative decrease of effectiveness due to appearance of tolerant *Aspergillus*-group strains to mercury.

It is generally believed that Ceresan lime should be changed to other safer disinfectants as soon as possible, based chiefly on the first reason in Thailand.

This study was undertaken repeatedly to find out applicable disinfectants to the control of *Aspergillus* disease of silkworm, followed by the previous reports.(4)(5) In this paper, "New Pafsol" and "Kabinoran" which have been used widely and effectively in controlling the diseases as substitute of Ceresan lime in Japan, in addition to Chlorinated lime and Pafsol produced in Thailand, were tested for practical use in the country.

MATERIALS AND METHODS

1.	The silkworm race used	:	K14 x K1
2.	The disinfectants tested	:	New Pafsol (RIKEN Adsol Industry Co.), Thai Pafsol (the government phamaceutical organization), Kabinoran (TAKEDA Chemicals Industry Co.) and Chlorinated lime (VIDHYASOM Co., Ltd.)
3.	The time of tests	:	January to October, 1978
4.	The strain of *Aspergillus*	:	The isolate of *Aspergillus* flavus (P_{12})

The 1st-, 2nd- and 4th- instar larvae just after ecdycis were employed. The concentration of spore suspension was adjusted to 4×10^3 spores per mm^3. Seventy larvae were used in each treatment with 5 replications. The larvae of each treatment with the same size were randomly collected from silkworms reared as 1 batch. The larvae were inoculated a dipping method. Application of chemicals was made a time in each instar. Dosages of chemicals applied to the 1st-, 2nd- and 4th-instar larvae were 10, 30, and 50 g per 1 m^2, respectively. The worms were fed by being wrapped with paraffin paper. The mortality of larvae was daily recorded. The tests were terminated when the larvae reached the 3rd-, 4th-instar and pupa stage, respectively.

RESULTS AND DISCUSSION

Results are shown in Tables 1-3. In the tests on 2nd- and 4th-instar in January and June rearing season, "New Pafsol" and "Thai Pafsol" showed the effect in controlling the disease Ceresan lime was most effective. In August rearing season, the disease was effectively controlled by dusting "New Pafsol", "Thai Pafsol", and "Kabinoran", respectively. In the tests on 1st-, 2nd- and 4th-instar in October rearing season, "New Pafsol", "Thai Pafsol", and "Kabinoran" were efficacious against the disease, but the effectiveness was inferior to the Ceresan lime.

From the results obtained, Ceresan lime was most effective in controlling *Aspergillus* disease in every application to 1st, 2nd and 4th-instar silkworms, followed by "New Pafsol", "Thai Pafsol", and "Kabinoran" or Chlorinated line in order.

Concerning to *Aspergillus* group fungi, in Japan, among other causative ones of silkworms, it was shown that their high tolerant isolates to mercury fungicide or formaldehyde had distributed abundantly in rearing environment of silkworms. [2, 3] Consequently, it has been recognized that the effectiveness of disinfectants containing these chemicals as the main active ingredient on the practical uses of them have been relatively lowered. KABASAWA *et al.* [1] reported, using tolerant *Aspergillus* strains to formalin, that "Kabinoran", in general, was superior or equal at least to either Ceresan lime or Pafsol in its effectiveness to *Aspergillus* and Muscardine diseases. The results reported repeatedly in our experiments showed unexpectedly that Ceresan lime was most effective in controlling *Aspergillus* disease, followed by "New Pafsol", "Thai Pafsol" and "Kabinoran" or Chlorinated lime in order. This may be caused by the difference of the strains used in the experiments. However, it may be concluded that "New Pafsol", "Thai Pafsol", and "Kabinoran" have sufficient effectiveness as safer disinfectants for practical uses in controlling fungus diseases of silkworms, though they might require more careful administration to silkworms than Ceresan lime. Chlorinated lime will require further investigation in its effectiveness for practical use.

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Table 1. Mortality (%) of 2nd- and 4th-instar larvae in January and June rearing season, 1978

Disinfectant	2nd-instar		4th-instar
	January rearing season	June rearing season	January season
New Pafsol	12.6	15.1	11.4
Thai Pafsol	16.5	26 8	16.0
Chlorinated lime	24.6	20.8	16.0
Ceresan lime	5.1	6.0	6.9
Check (no disinfection)	99.4	100.0	81.7

Remarks: Mortality of silkworm (%). The average of 5 replications.

Table 2. Mortality (%) of 2nd- and 4th-instar larvae in August rearing season, 1978

Disinfectant	2nd-instar	4th-instar
New Pafsol	13.7	11.7
Thai Pafsol	33.4	18.0
Kabinoran	26.5	33.4
Chlorinated lime	69.4	21.7
Ceresan lime	6.6	5.1
No disinfection	99.7	67.4

Remarks: See Table 1.

Table 3. Mortality (%) of 1st-, 2nd, and 4th-instar larvae in October rearing season, 1978

Disinfectant	1st-instar	2nd-instar	4th-instar
New Pafsol	43.3	16.8	16.6
Thai Pafsol	19.1	28.0	16.6
Kabinoran	50 9	25.1	29.1
Ceresan lime	0.8	7.1	3.2
No disinfection	99.7	100.0	58.9

Remarks: See Table 1.

38. Effect of Formalin Disinfection on Spore Population and Disease Occurrence of Aspergillus in a Cooperative Rearing House of Young Silkworms (I) Dry Season

Laksanawadee ISARANGKUL, Thongchai SITTISONGKRAM,
Sukit THAMPRANEE and Takashi ISHIJIMA

In Thailand, cooperative rearing of young silkworms is gradually extending. One of the purposes of this rearing system is to supply farmers with healthy and uniform silkworms in 3rd sleep, by taking more careful and concentrated control over the young stage silkworms susceptible highly to many kinds of pathogen. Thus, the rational control of diseases at the cooperative rearing house will give big effects to stabilize cocoon crop of every farmer to whom young silkworms will be delivered at that rearing season.

On the other hand, as a result of trapping of *Aspergillus* spores to judge the effect of formalin disinfection in the cooperative rearing house, we recognized high population of the spores even after disinfection. So we began to work systematically on the population and its seasonal prevalence of *Aspergillus*, the effects of disinfection on the population, and the actual occurrence of the disease in the cooperative rearing house of young silkworms. This paper deals with the results of the work done at the cooperative rearing house of Pimai self-help land settlement in dry season in 1978.

MATERIAL AND METHODS

1.	Locality surveyed	:	Pimai self-help land settlement, Pimai, Korat
2.	Time of survey	:	Preliminary spore trapping; October rearing season (Hakitate, Oct. 15, 1978). Spore trapping and rearing test; November rearing season (Hakitate, Nov. 20, 1978; silkworm race reared, K1xK8, and about 45 sheets of eggs).
3.	Rearing house	:	Floor area, 10 m x 21 m Structure; a steel frame skelton, Floor; concrete.
4.	Disinfection	:	Prior to the beginning of each rearing, the 1st disinfection with 3% formalin solution, washing and cleaning, and then 2nd disinfection with formalin solution were generally done. October rearing season; 1st disinfection, September 20, (amount of formalin solution used, 560ℓ), 2nd disinfection, Oct. 12 (amount of formalin solution used, 560 ℓ) November rearing season; 1st disinfection: Nov. 6 (amount of formalin solution used, 560ℓ). 2nd disinfection; Nov. 15, (560 ℓ).
5.	Rearing tray	:	Hanging bed type, wooden framed tray with iron net.

RESULTS

(1) Trapping of *Aspergillus* spores.

A method of trapping *Aspergillus* spores by using a filter paper and Rose Bengal agar [3] was reported in the previous papers [1], [4]. In this investigation, a round filter paper of 7 cm in diameter was used instead of a 4 cm square one used previously. In the preliminary trapping of

October rearing season, six, four, and twenty petri dishes containing each sheet of sterilized filter paper were randomly put in the mulberry storing and chopping rooms, and rearing room, respectively, and then they were exposed for five hours for trapping. The trapping was made twice, after 1st disinfection and on the second day after "Hakitate" continued from the 2nd disinfection, by being requested to judge the effects of formalin disinfection of the house. The result obtained was shown in Table 1.

The population of *Aspergillus* spore was unexpectedly high, especially in rearing room, even after the first formalin disinfection. Then, in the second trapping on the second day after "Hakitate", the population increased still more in every room, being more than 31 colonies per dish, though the second disinfection had been made only five days ago.

In November rearing season, four, three, and twelve dishes were put in mulberry storing and chopping rooms, and rearing room, respectively, before being exposed for one, three, and five hours for trapping. Trapping was made six times, i.e. before disinfection, after 1st and 2nd disinfection and on the end of each instar until 3rd instar.

The population of *Aspergillus* spores was generally low compared with the preceeding rearing season. Before disinfection, the population was considerably high in every room, decreasing remarkably after the 1st and 2nd formalin disinfection. Especially, the effect of the disinfection was conspicuous in rearing room, and the number of colonies per dish ranged 0.2 to 0. This fact proved that cleaning and disinfection of the house were highly effective. However, as the rearing days passed by, the population reached the highest level in the second instar, showing its increasing tendency. Throughout whole period of rearing, mulberry storing and chopping rooms seemed to be more polluted with *Aspergillus* spores.

(2) Inspection of *Aspergillus* spores in rearing beds.

Generally, rearing beds containing aboundantly feces and litters provided a favorable environment for growth of *Aspergillus*.

In November rearing season, the silkworms from 45 sheets of eggs were reared in each rearing tray containing one sheet of worms with body surface disinfection, using Ceresan lime twice for each instar. Specially, among them we made one tray to rear silkworms from one sheet of eggs without body surface disinfection. For the inspection of *Aspergillus* population in rearing beds, ten samples of feces and litters were collected from each of ten rearing trays selected at random at the end of each instar, as one sample from the tray without body surface disinfection. About 1 g. of each sample was well suspended with 10 ml of sterile distilled water Two ml of each suspension were mixed with 10 ml of Rose Bengal agar at about 50°C in a Petri dish to be incubated at 30°C for three days, and the colonies of *Aspergillus* developed on a solid agar plate were counted. Two dishes were used for each sample.

The results (Table 2) showed that the population was highest at the first stage, having no increasing tendency with advancement of silkworm age. The sample from a rearing tray without body surface disinfection did not show high population in particular. These facts might be attributed to good cleaning of rearing beds.

(3) Inspection of infection with *Aspergillus* in young silkworm larvae.

Careful and visual inspection revealed no silkworms affected with *Aspergillus* in rearing beds. For the inspection of infection with *Aspergillus* in each instar of young larvae, one thousand of larvae were collected from ten rearing trays with body surface disinfection selected randomly at the end of each instar. The same number of larvae were laso collected from a tray without disinfection. A swarm of these larvae were separatedly put on Rose Bengal agar medium after body surface sterlization (bodies were immersed in 70% alcohol solution for two

minutes, before rinsed three times with sterile distilled water) at our laboratory of the Centre. After three days incubation at 30°C, the larvae which produced *Aspergillus* were referred to "infected".

The infection rates of both specimen larvae were remarkably low, and no difference was recognized between two groups with or without body surface disinfection (Table 3).

(4) Rearing test of adult silkworm larvae.

For the rearing test of adult silkworms, about three thousand silkworms in 3rd sleep collected randomly from each rearing tray with or without body surface disinfection were taken back to the Centre and reared in a rearing room there, as if a farmer received delivery of silkworms from a cooperative rearing house. The silkworms of each group, decreased to two thousands in number on the day immediately after the third ecdysis, were examined on the disease occurrence in the stages of old silkworm and cocooning. No occurrence of *Aspergillus* disease was observed in these silkworms, though flacherie disease or parasite flies killed a few of them. As a result, the rates of good cocoons attained to 95.4 and 94.5 percent, in the groups with or without doby surface disinfection, respectively (Table 4).

DISCUSSION

Considering from the results obtained here, the population of *Aspergillus* spore was highly decreased, when formalin disinfection was considerably well made in advance of "Hakitate" in a cooperative rearing house. Subsequently, the spores did not attain enough population for causing big bad crops, though it showed an increasing tendency with progression of silkworm age. ISARANGKUL *et al.* pointed out that the average number of *Aspergillus* colony per dish was as high as 212 to 217, when there was a serious damage by the disease in the rearing season of May – June

There was a big difference in the population of *Aspergillus* spore by trapping between in the rearing seasons of October and November This cause was not clear, partly because the workings of disinfection might be insufficient, partly because different climatic conditions or long closing of the house after the preceeding rearing season of June might give beneficial effects on controlling of *Aspergillus*.

Needless to say, diseases of silkworms are transmitted and produced as a result of complicated interaction among many factors such as the strength and amount of pathogens, resistance of worms, temperature and humidity and others. In this paper, even silkworms without body surface disinfection made exceptionally good cocoons at a high rate This seems to be attributed to better effects of formalam disinfection resulting in the lowering of *Aspergillus* spore population, and to the inhibition of multiplication of the pathogen due to better management of silkworms, facilities and tools of the house, and to climatic benefit of dry season

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Table 1. Trapping of *Aspergillus* spores in the cooperative rearing house (October rearing season, 1978)

Trapping	Location / No. of plate used / No. of colony	5–10	11–20	21–30	>31
After 1st formalin disinfection[1]	Mulberry storing room 6	o	oo	ooo	
	Mulberry chopping rrom 4	o	o	o	o
	Rearing room 20		oo	ooooo ooooo	ooooo ooo
1st inster, 2nd day[2]	Mulberry storing room 6				ooooo o
	Mulberry chopping room 4				oooo
	Rearing room 20				ooooo ooooo ooooo ooooo

Note 1. 1st disinfection: Sept. 20, Trapping: Oct. 6
2. 2nd disinfection Oct. 12, Hakitate: Oct. 15, Trapping: Oct. 16, Exposure time of plate: 5 hours.
3. o shows the petri-dish to have the number of colony of upper column.

Table 2. The population of *Aspergillus* spores in rearing beds of the cooperative rearing house.

No. of colony / Silkworm age	0	1–5	6–10	11–20	> 21
1st instar	oooo		o •	o	oooo
2nd instar	ooooo o	oooo •			
3rd instar	oooo	ooooo •			o

Note: Samples of feces and litters were collected at the end of each instar
o Samples from rearing tray with body surface disinfection.
• Samples from rearing tray without body surface disinfection.
The number of colony was shown in average of two Petri dishes for each sample.

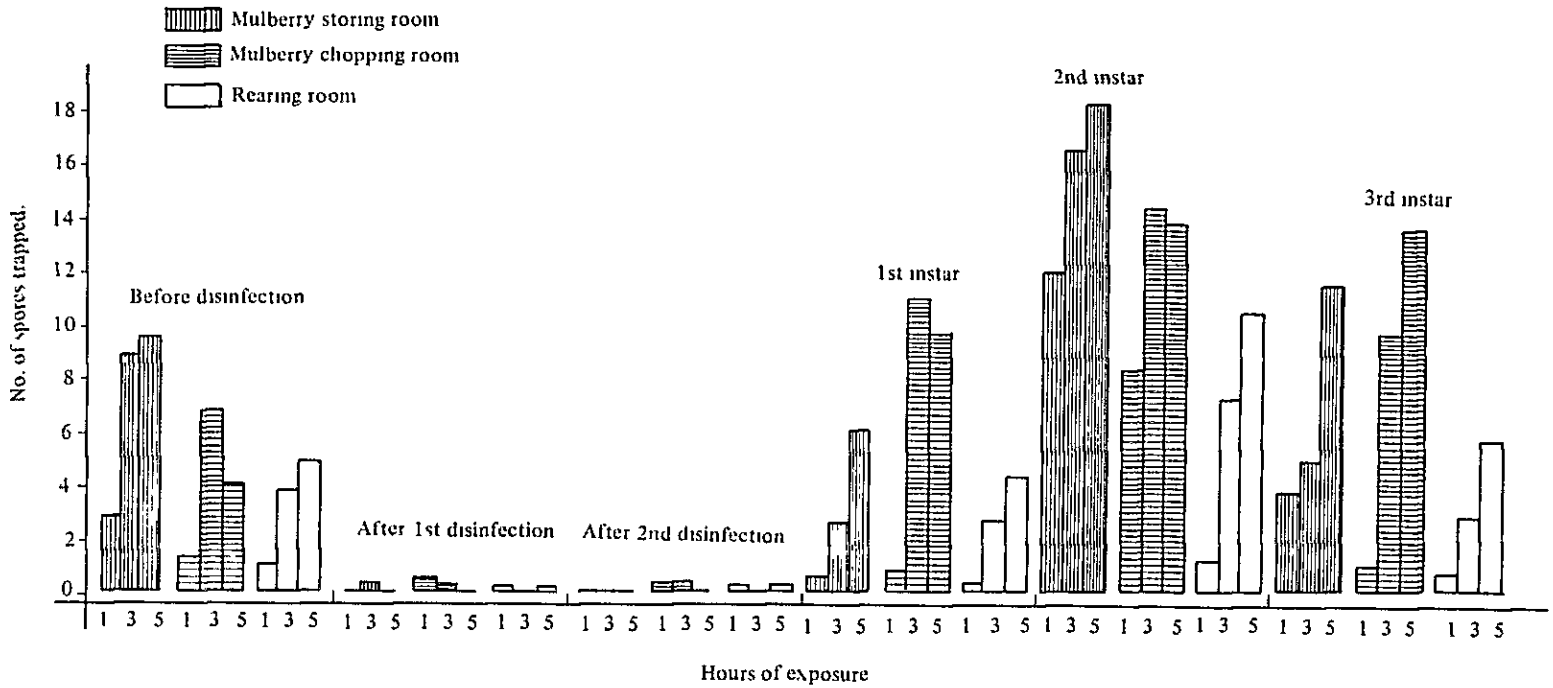

Fig. 1. The population of *Aspegillus* spores in cooperative rearing house (November rearing season, 1978)

Table 3. Infection with *Aspergillus* in young silkworm larvae

Age of silkworm	Body surface disinfection	No. of tested	No. of infected
1st instar	Done	1,000	4
	Not done	1,000	1
2nd instar	Done	1,000	0
	Not done	1,000	2
3rd instar	Done	1,000	1
	Not done	1,000	0

Note: The larvae were individually tested in the end of each instar on Rose Bengal agar.

Table 4. Rearing test of old silkworm larvae from the cooperative rearing house

Body surface disinfection	No. of larvae of 4th instar	No. of larvae of 5th instar	No. of larvae mounted	No of good cocoon	No. of dead cocoon	Dead in mounting	*No. of missing silkworms
Done	2,000	1994 (dead 6, 0.3%)	1994	1907 (95.4%)	55 (2.8%)	4 (0.1%)	28 (1.4%)
Not done	2,000	1994 (dead 6, 0.3%)	1994	1889 (94.5%)	28 (1.4%)	5 (0.3%)	72 (3.6%)

Note: 1. Delivery of silkworms from the cooperating rearing house: Nov. 30.
2. Dead silkworms were not affected with *Aspergillus*.
3. Mounting. Dec. 13–14, 1978.
* Some of these silkworms were eaten by a kind of lizard.

39. Investigation on Protection of Silkworms from the Diseases to Stabilize the Cocoon Yield, with Special Regard to the Serioultural Practices in Cooperative Rearing House of Young Silkworms and Farmhouses (1)

Takashi ISHIJIMA, Thongchai SITTISONGRAM, Sukit THAMPRANEE,
Sumanee KWANMING, and Laksanawadee ISARANGKUL

This investigation aimed at the following points:

(1) To survey the respective relationship between kind and amount of pathogens causing serious silkworm diseases and actual occurrence of the diseases.

(2) To survey distribution and seasonal prevalence of the pathogens under rearing envrionments and to clarify infection routes of the diseases

(3) Improvement of disinfection to rearing rooms, tools, equipments, and silkworms under different environmental rearing conditions.

MATERIALS AND METHOD

1. Locality suuveyed. Self-help land settlement, Pimai, Korat.

   (1) Cooperative rearing house of young silkworm.
   (2) 3 sericultural farmhouses among settlers.

General situations of rearing houses and silkworm rearing in a cooperative rearing house and three farms: Shown in Table 1.

2. Items surveyed

   (1) Amount of cocoon harvested. Cocoon yield per box or sheet was surveyed after each rearing season every sericultural farm, relating to the total damages by diseases.
   (2) Occurrence of the diseases in grown silkworms. Collected at the grown stage, diseased, underdeveloped, and dead silkworms from each farm were diagnosed by means of dissection and microscopical observation, except some silkworms with distinct signs of known etiology.
   (3) Kind and amount of the pathogens of the diseases in rearing environment.

A. Feeding tests of dust-smeared mulberry leaves.

   a. Inoculum: Each 2 to 4 dust samples were collected from the applicable sites to estimate kind and amount of the pathogen.

   b. Time to collect inculum: Before and after disinfection, prepared for silkworm rearing, and at grown silkworm stage in each rearing season. The dust samples collected were stored in a refrigerator until their tests.

   c. Inoculation: Healthy silkworm larvae newly hatched were fed on dust-smeared mulberry leaves during 1st instar, supplied with the leaves twice a day.

   d. Rearing of silkworms tested 50 larvae x 2 replications per plot (variety, K1xK8) were reared in each plastic box until the 2nd day of the 4th instar as usual. Rearing of silkworms were comprehensively begun at the different date of "Hakitate"

on Jan. 18, and 29, 1979, respectively. Body surface disinfection was made to the silkworms from the 2nd instar.

e. Observation. Dead, diseased, and abnormally under-developed larvae were daily collected and recorded, respectively, followed by dissecting the bodies, kept in a moist chamber for about two days, and microscopical observations to investigate their causualities.

B. Media tests of *Aspergillus* in dust sample.

a. About 1 g of each dust sample above mentioned was well suspended with 10 mℓ of sterile distilled water. Two mℓ of each suspension were mixed with 10 mℓ of Rose Bengal agar medium at about 50°C in a petri dish to be incubated at 30°C for three days, and the number of colonies of *Aspergillus* developed on a solid agar plate was counted.

RESULT

(1) Amount of cocoon harvested

Cocoon yield per box in May rearing season before this survey was generally low, especially in Farm B. It was remarkably low in a degree to be suspected "a bad crop", attaining the only 14.3 kg. This was reportedly caused by a high incidence of the disease at the time of mounting. However, it has been highly improved with stability of cocoon production in each farm since August rearing season, though the silkworms in that season were reared from the time of "Hakitate" in the respective rearing house without usage of cooperative rearing house of young silkworms. Subsequently, in October rearing season at the end of the wet season, the yield of cocoon per box attained as high as 29.8, 30.5, 30.8 kg in A, B, and C farms, respectively.

(2) Inspection of the diseases in grown silkworms.

The results of inspection in each farm are shown in Table 2. The Occurrence of the disease was generally less in the grown silkworms throughout August to November rearing seasons, resulting in good crops of cocoons. The kinds of the disease were considerably limited in number. From the results, flacherie diease was almost constantly dominant among the diseases occurred throughout every rearing season. However, in the rearing seasons of October and November, flacherie disease might include cytoplasmic polyhedrosis disease, because the polyhedrosis was not checked in midgut of the flacherie- diseased worms. *Aspergillus* disease also, occurred prevalently in each farm in the two seasons of August and October. There were very few silkworms to be made clear diagnoses of cytoplasmic or nuclear polyhedrosis in these rearing seasons Damages by *Fusarium* disease or parasitic fly were sporadically recognized

In addition, in August rearing season of Farm A, the growth of silkworms was recognized very well until the 5th instar, with very few diseases, however the yield of cocoon was unexpectedly less than the other farms. Because there appeared reportedly a number of uncocooning silkworms during mounting. This pathological cause should be made clear by further investigation, in relation to low yield of cocoon in November rearing season, because of being suspicious of infectious disease occurrence in the farm.

(3) Feeding tests of dust smeared mulberry leaves.

The disease occurrence in the silkworms fed on mulberry leaves smeared with dust collected from rearing environment are shown in Tables 3 – 6 On the whole, the kinds of pathogen detected were limited in number, and first of all *Aspergillus* and secondly, nuclear polyhedrosis pathogens were prevalently detected from dust samples Flacherie disease, also.

was detected in each farm Cytoplasmic polyhedrosis was detected in only one case from Farm A's mounting room on Sept. 1. In addition, there appeared constantly some silkworms showing abnormally delayed development without any distinct signs of the diseases until the end of 4th instar to be investigated.

The cooperative rearing house was not used for rearing in August, but in the seasons of October and November. In the rearing room of the house, *Aspergillus* was detected at a high rate on Oct. 6 even after formalin disinfection. In the mulberry chopping room, it was also detected at a high rate after the rearing of October and November seasons. In the mulberry storing room, it was detected before each formalin disinfection, but decreased highly after the disinfection. In the dark room, also, high effects of disinfection was seen, however, nuclear polyhedrosis diease was detected after October rearing season as only one case throughout the cooperative rearing house This suggests the room was easily contaminated with pathogens, because it was located at the nearest site to outside.

In case of Farm A, in the rearing room for grown worms *Aspergillus* was detected at a high rate on Nov. 20, but nuclear polyhedrosis was detected in only one case before formalin disinfection of Sept. 1. In the rearing room for young silkworms the rate of detection was remarkably low. The mulberry storing room was generally polluted with pathogens, especially *Aspergillus* at a high rate before disinfection or at grown silkworm stage, caused by frequent transportation of the leaves to the room. *Aspergillus* was detected at a high rate on Nov. 29, even after disinfection. So it was of the most important to carry out disinfection as thoroughly as possible. Mounting room without any disinfection was in danger of high contamination with many kinds of pathogen, especially relating to much occurrence of uncocooling worms during mounting Subsequently, nuclear and cytoplasmic polyhedrosis were detected as a result of contamination in the preceeding season In the dark room, *Aspergillus* was detected at considerably high rate on Nov. 29 after disinfection, suggesting that the contamination might be originated from the entrance of rearing house.

In case of Farm B and C, a similar tendency to Farm A was shown.

(4) Media tests of *Aspergillus* from dust sample.

Media tests revealed that dust samples collected from each rearing environment of the cooperative rearing house or farmhouses contained frequently a fair number of *Aspergillus* spores before as well as after formalin disinfection, and that the spores might be more endurable in the dust sample than in the air against the disinfection, though they were perfectly or partly destroyed in some cases after disinfection. Some dust samples which made a number of colonies on a agar plate caused coincidently high incidence of *Aspergillus* disease with a few exceptions.

DISCUSSION

There is a method which is being used broadly and effectively in order to clarify the existence of pathogens of silkworm diseases, especially their kinds and amount, infection sources, and effect of disinfection. Namely, young silkworms fed on mulberry leaves smeared with the dust sample, collected from various rearing environment, represent clearly a disease with its pathogen. As a result, it is possible to elucidate some factors causing bad crops in each farm. However, we have to keep in mind about some restrictions in this method for the appropriate interpretation of the results obtained. First, there is the difference of incubation period or infection route among silkworm diseases, for example, *Aspergillus* disease with a usually short incubation period might kill a number of worms tested before expression of other disease symptoms. In addition, silkworms are infected with *Aspergillus* through only their skins, on the other hand many kinds of virus are transmitted through mouth, as though the inoculum of dust in this test is given to silkworms Secondly, weight or amount of dust sample to be adhered on mulberry leaf is different, depending on the ingredients in a dust sample

collected. These restrictions might cause the possibility of unproper reflection on the genuine facts in the rate or kind of the disease occurrence. So this is said to be a method of "qualitative" rather than "quantative" estimation on the pathogens.

Judging from the results described in this paper, it may well be said that the kinds of the diseases were considerably limited in number in both cooperative rearing house and three farms, being predominated by *Aspergillus*, nuclear polyhedrosis, and flacherie diseases. This might be caused by the facts that the workers of the house of farms surveyed were well advanced in sericultural techniques and well performed routine disinfection, to the degree of being resulted in a fairly good crops of cocoon, and were helped by climatic benefit of the dry season.

On the basis of the results, it may be obviously concluded that rearing environment of farms in Thailand is highly and constantly polluted with the pathogens above mentioned Moreover, this pollution might be decreased by formalin disinfection, though there were a few exception. Some of the pathogens, especially *Aspergillus*, remaining after, disinfection, may be kept off by later disinfection of body surface of silkworms. Thus, these results seem to give a special emphasis on the importance of disinfection to be performed as thoroughly as possible, because the media test showed that *Aspergillus* have remained frequently in dust samples even after disinfection.

Silkworms with flacherie disease were recognized constantly at a low rate without any outbreak of the disease, showing sporadical features due to probable bacterial or phisiological cause, but not infectious. Further investigation will be requested to make clear the cause of this flacherie as well as underdeveloped silkworms occurred frequently after feeding on dust sample.

Table 1. General situation of rearing houses and silkworm rearing

	Rearing house	Silkworm rearing				
			May	Aug.	Oct	Nov.
Cooperative rearing house	Structure; a mortared frame house Space of floor; 21 m x 10 m Floor; concrete made	No of box or sheet reared Hakitate Distribution Average yield of cocoon in farms distributed (per box)	no use (May 20)	no use (62) (Aug. 28) – (21.3)	43 Oct. 15 Oct. 24 28.3	33 Nov. 20 Nov. 30 19.0
Farm A	Structure, for adult; a concrete block house. For young, a wooden house, lower floor of dwelling Space of floor; for young 9m × 6m, for adult, 16m × 6m Floor, concrete made Mounting room, different from rearing room, lower floor of dwelling	Variety reared No. of box or sheet reared Amount of cocoon harvested (per box) kg	Japanese 3 60–70 (20–23)	Japanese 3 63.2 (21.1)	Japanese (KINSHU× SHOWA) 2 59.6 (29.8)	K1×K8 1 15.0 (15.0)
Farm B	Structure; a concrete block house Space of floor; 11m × 5m Floor; concrete made Mounting room; same as rearing room	Variety reared No. of box or sheet reared Amount of cocoon harvested (per box)	3 43.0 (14.3)	Same as A 3 70.5 (23.5)	2 60 9 (30.5)	3 62.7 (20 9)
Farm C	Structure; same as B Space of floor; 14m x 6m Floor, concrete made Mulberry storing room; two separated Mounting room, same as A	Variety reared No. of box or sheet reared Amount of cocoon of cocoon harvested (per box)	3 80 (26.7)	4 95.7 (23.9)	Same as A 2 61.9 (30.8)	4 83.1 (20.8)

Table 2. Disease occurrence in each farm

Seasons of rearing (date of collection)	Farms	No of * specimen	Diseases					
			N	C	F	K	Fu	P f.
August (Sept. 18)	A	6	0	0	2	2	2	0
	B	31	2	0	24	4	0	0
	C	11	0	2	0	8	0	1
October (Nov. 3)	A	6	1	4**		1	0	0
	B	13	0	6**		5	1	1
	C	22	2	18**		1	1	0
November (Dec. 11)	A	3	0	0	0	0	0	3
	B	8	0	8**		0	0	0
	C	7	0	7**		0	0	0

N : Nuclear polyhedrosis disease
C : Cytoplasmic polyhedrosis disease
F . Flacherie disease
K · *Aspergillus* disease
Fu : *Fusrium* disease
P f. : Parasitic fly
* The number of silkworm, which delayed in growth but made later a normal cocoon, was removed out.
** Cheking of polyhedrosis in midgut was not done. The number may include both C and F.

Table 3. Disease occurrence of the silkworms fed on mulberry leaves smeared with dust sample collection from rearing environment (1) Cooperative rearing house of young silkworms

Place	Date of collection	Working state		Rate of disease (%)						No. of colony with *Aspergillus*	Remarks
		Rearing	Disinfection	K	N	C	F	Ab	Total		
Rearing room	Sept. 18	Before	Before	3.0	0	0	0	4.0	7.0	⊕	1st Disinfection. Sept. 20
	Oct. 6	Before	After 1st	24.5	0	0	1.0	2.0	27.3	⊕ ⊕	2nd Disinfection· Oct. 13
	Oct. 16	Before	After 2nd	7.1	0	0	1 0	5.1	13.2	⊕	Hakitate. Oct. 15
	Oct 25	After	Before	0	0	0	0	0	0	⊕ ⊕	Delivery of silkworms.
	Nov. 17	Before	After	0	0	0	0	4.0	4.0	–	Oct 24
	Dec 17	After	Before	4.0	0	0	0	0	4.0	ND	
Mulberry chopping room	Sept. 18	Same as those in rearing room		10 0	0	0	3.0	2 0	15.0	⊕ ⊕	1st Disinfection Nov. 6
	Oct 6			1.0	0	0	2 0	2.0	5 0	⊕	2nd Disinfection Nov. 15
	Oct 16			1.0	0	0	0	6.0	7.5	⊕	Hakitate· Nov. 20
	Oct 25			39.8	0	0	0	2.0	41.8	⊕ ⊕	Delivery of silkworms.
	Nov. 17			0	0	0	0	2 0	2.0	–	Nov. 30
	Dec 11			25.3	0	0	0	2.0	27.3	+ + + + +	
Mulberry storing room	Sept 18	Same as those in rearing room		14 1	0	0	0	0	14.1	⊕ ⊕	
	Oct 6			6 1	0	0	0	9.1	15.2	+ +	
	Oct. 16			0	0	0	2 0	0	2 0	+ +	
	Oct 25			100.0	0	0	0	0	100.0	⊕ ⊕	
	Nov 17			0	0	0	0	2.0	2.0	–	
	Dec 17			9.0	0	0	0	0	9.0	⊕ ⊕	
Dark room	Oct 6	Before	After 1st	0	3 0	0	1.0	5 1	9.1	+ + + +	
	Oct. 16	Before	After 2nd	0	0	0	0	0	0	⊕	
	Oct. 25	After	Before	8.2	1 0	0	0	1.0	10 2	⊕	

Remarks 1 K, N, C, and F· See Table 2. Ab Silkworm abnormally delayed in development without distinct signs of the diseases
2 The rates are shown in average of two replications of each 50 larvae
3 Number of colony of *Aspergillus* is shown in the following

0	= -	31 - 40	= ++++
1 - 10	= +	41 - 50	= +++++
11 - 20	= ++	> 50	= ⊕
21 - 30	= +++	> 100	= ⊕ ⊕

ND = Not done

Table 4. Disease occurrence of the silkworm fed on mulberry leaves smeared with dust sample collection from rearing environment (2) Farm A

Place	Date of collection	Working state		The rate of disease (%)						No of colony *Aspergillus*	Remarks
		Rearing	Disinfection	K	N	C	F	Ab	Total		
Rearing room for old silkworms	Sept 1	Before	Before	3 2	3.2	0	0	1 1	7 5	⊕⊕	1. 5th instar, 5th day, good growth
	Sept. 18	Old	(1)	0	0	0	0	3 1	3 0	+	2. 5th instar, 5th day, excellent growth
	Oct 6	Before	Before	12 1	0	0	0	2 0	14 1	⊕ ⊕	3 5th instar, 5th day, slight Smaller body, not diseased Smaller body, not diseased
	Oct 25	Before	After	1 0	0	0	0	1 0	2 0	++	
	Nov 3	Old	– (2)	0	0	0	0	3.0	3.0	⊕	–Disinfection Aug 25 (Amount of formalin, 3 l.)
	Nov 20	Before	Before	44 0	0	0	0	2.0	46.0	⊕ ⊕	
	Nov. 29	Before	After	2.0	0	0	0	1.0	3.0	⊕ ⊕	- Disinfection Sept. 14 (Amount of formalin 3 l.)
	Dec 11	Old	– (3)	5 2	0	0	0	0	5 2	++++	
Rearing room for young silkworms	Sept 1	Young	After	0	0	0	0	0	0	+++	–Delivery of silkworms from rearing house Oct 24
	Sept 16	After		2 0	0	0	0	2 0	4 0	+++++	
	Oct. 16	After	Before	0	1.0	0	2.0	–	3.0	⊕ ⊕	-Disinfection Nov. 23 (Amount of formalin, 4 l.)
Mulberry storing room	Sept. 1	Same as those in rearing room for olf silkworms		1.1	3.2	0	0	3.2	7.5	+++	
	Sept. 18			3.0	0	0	0	1 0	4.0	⊕ ⊕	
	Oct. 6			23.1	1.1	0	0	1 1	25 3	⊕ ⊕	
	Oct. 25			2.0	0	0	0	1.0	3.0	+++++	
	Nov 3			79 0	0	0	0	1.0	80.0	⊕ ⊕	
	Nov. 20			19.2	0	0	0	3.0	22 2	ND	
	Nov. 29			25 5	0	0	0	3.1	28.6	⊕ ⊕	
	Dec. 11			16.2	0	0	0	0	16.2	+++++	
Mounting room	Sept 1	Before	No	0	32.3	2.0	1.0	3.0	38 3	–	
	Sept. 18	Before	No	5.0	0	0	0	2.0	7.0	–	
	Oct. 6	After	No	0	0	0	0	1 0	1.0	+	
	Nov. 3	Before	No	0	0	0	0	3.0	3 0	⊕ ⊕	
	Dec. 11	Before	No	23.0	2.0	0	0	3.0	28 0	⊕ ⊕	
Dark room	Nov 29	Before	After	16.2	0	0	0	0	16 2	⊕	

Table 5. Disease occurrence of the silkworm fed on mulberry leaves smeared with dust sample collection from rearing environment (3) Farm B.

Place	Date of collection	Working state		The rate of disease (%)						No. of colony, *Aspergillus*	Remarks
		Rearing	Disinfection	K	N	C	F	Ab	Total		
Rearing room for old silkworms	Sept 1	Young	After	4.0	0	0	0	2 0	6.0	ND	Disinfection Aug 25 (Amount of formalin, 4 l)
	Sept 18	Old	–	1.0	0	0	0	2 0	3.0	⊕ ⊕	
	Oct 6	Before	Before	7.0	10 0	0	0	0	17.0	⊕	
	Oct 25	Before	After	17.2	0	0	0	0	17 2	ND	
	Nov 3	Old		0	0	0	0	2 0	2.0	+++	
	Nov 20	After	Before	5 1	0	0	0	1.0	6 1	⊕ ⊕	
	Nov. 29	Before	After	9.0	0	0	0	1.0	10.0	⊕ ⊕	
	Dec. 11	Old	–	0	0	0	0	0	0	+	
Mulberry storing room	Sept 1	Same as stated above		0	0	0	0	0	0	ND	
	Sept 18			0	0	0	0	1 0	1 0	+	
	Oct 6			77 0	0	0	0	0	77.0	ND	
	Oct. 25			0	0	0	0	1 0	1 0	++	
	Nov. 3			0	0	0	0	0	0	ND	
	Nov 20			23.2	0	0	0	1 0	24.2	+++++	
	Nov. 29			0	0	0	0	0	0	+	
	Dec 11			21.0	0	0	4.0	0	25.0	⊕ ⊕	
Dark room	Sept 1	Young	After	1 0	1 0	0	0	1 0	3 0	ND	

Table 6. Disease occurrence of the silkworm fed on mulberry leaves smeared with dust sample collection from rearing environment (4) Farm C

Place	Date of collection	Working state		The rate of disease (%)						No. of colony, *Aspergillus*	Remarks
		Rearing	Disinfection	K	N	C	F	Ab	Total		
Rearing room for old silkworms	Sept 1	Young	After	5 0	0	0	2 0	5 0	12.0	⊕	
	Sept. 18	Old	-	0	0	0	1.0	3 0	4.0	++	
	Oct 6	Before	Before	59.6	0	0	0	2 0	61.6	⊕ ⊕	
	Oct 25	Before	After	100.0	0	0	0	0	100 0	ND	
	Nov 3	Old	-	4.0	0	0	1.0	4.0	9 0	⊕ ⊕	
	Nov. 20	Before	Before	44.4	0	0	0	4 0	48.4	⊕	
	Nov 29	Before	After	7 0	0	0	2 0	2 0	11.0	⊕	
	Dec 11	Old	-	33 3	5 1	0	4 0	5.1	47 5	-	
Mulberry storing room 1	Sept 1	Same as stated above		5.0	1.0	0	0	2 0	8.0	⊕	
	Sept 18			3.0	0	0	0	2.0	5.0	+++++	
	Oct. 6			0	0	0	0	0	0	⊕ ⊕	
	Oct. 25			12 0	0	0	0	5 0	17 0	+++	
	Nov. 3			14.0	0	0	0	0	14.0	⊕	
	Nov. 20			19 2	0	0	0	3 0	22.2	ND	
	Nov. 29			4.0	0	0	0	1.0	5 0	+++	
	Dec 11			3.0	0	0	0	0	3.0	+++	
Mulberry storing room 2 (near entrance)	Sept 1	Young	After	36 7	0	0	2.0	0	38 7	⊕ ⊕	
	Sept. 18	Old	-	0	1 0	0	0	2 0	3.0	++	
	Oct 6	Before	Before	20 8	11.5	0	0	0	32.3	⊕ ⊕	
	Oct. 25	Before	After	0	0	0	0	4.1	4.1	+++	
	Nov 3	Old	-	16.0	0	0	0	2.0	18 0	⊕	
	Nov. 29	Before	After	1.0	0	0	0	0	1.0	+++	
Mounting room	Sept. 18	Before	No	1 0	0	0	0	1.0	2 0	+	
	Oct 6	Before	No	6 0	4.0	0	0	0	10 0	⊕ ⊕	
	Nov 20	After	No	2.0	0	0	0	3.0	5.0	+	

40. Effectiveness of DDVP and CCl_4 in Controlling of Mulberry Stem Borer, *Apriona germari* (Hope).

Thongchai SITTISONGKRAM

The mulberry stem borer, *Apriona germari* (Hope), is one of the most serious pests of mulberry in Thailand Young larvae begin to feed on the cambium of mulberry shoots, and then make a tunnel into the heartwood of shoots Moreover. they usually extend their tunnel to a downward direction For this reason the affected mulberry shoots become to stop their growth and are apt to blow down. Furthermore, the larvae keep to move gradually to the lower part of shoot, to main trunk and to roots of mulberry, eating each tissue, and result finally in the death of mulberry, due to complete destruction of the inside of main trunk and roots. However, this feeding time is in the habit of being accordant with the seasons of silkworm rearing, so it is necessary to find out a good chemicals having no long residual or having selective effects on silkworm in reference to controlling stem borer larvae

MATERIAL AND METHODS

This experiment was done in our laboratory. The chemicals used for this test were DDVP (2,2-Dichlorvinyl 0,0 dimethyl phosphate) and carbon tetra chloride (CCl_4)

The eggs of mulberry stem borer were collected from the fields of mulberry in the Centre. The newly hatched larvae were reared on the fresh shoots of mulberry, about 1–1.5 cm in diameter and 80–90 cm in length The lower end of each shoot was dipped in the water. The larvae hatched during the period of 8th to 17th of August were collected and used for this test. The larvae were reared on the same shoots for one month And, 0.1 mℓ of the chemicals in original concentration were injected into the hole, taking out feces, at the lowest part of each shoot. The mortality of larvae tested was checked on the 7th day after injection by dissecting shoot cuttings.

RESULTS AND DISCUSSION

The results were shown in Table 1. All of larvae tested, the control excepted, were killed by injecting of DDVP and carbon tetra chloride in about one week after injection. DDVP and carbon tetra chloride had a high poisonous effects on mulberry stem borers. So these insecticides will be applicable in controlling stem borers in the field. However, the concentration of the chemicals used in this experiment might be too much higher for practical use in the field. And, further investigation will be required to make the suitable dosage and concentration clear for controlling stem borers and to find out reasonable methods for practical application of these chemicals in the fields.

LITERATURE

(1) THAMPRANEE, S. and SETSUMI ITOI· Some observation on adult behavior and egg laying of mulberry stem borer Bul Thai Seri. Res. and Train. Centre, No. 6, 1976.

Table 1. Mortality of mulberry stem borer larvae by applications of DDVP and carbon tetra chloride

Date of hatching of larvae	Carbon tetra chloride	DDVP	Control
8 Aug.	5/5	5/5	0/5
9 Aug.	5/5	5/5	0/5
10 Aug.	3/3	3/3	0/3
13 Aug.	3/3	3/3	0/3
14 Aug.	4/4	4/4	0/4
15 Aug.	2/2	2/2	0/2
17 Aug.	2/2	2/2	0/2
Total	24/24	24/24	0/24
Total (%)	100	100	0

Remarks: No. of dead larvae/no. of larvae tested.
Date of experiment: July – Sept. 1978
Date of injection : 15 Sept.
Date of dissecting : 22 Sept.

41. An Example of Outbreak of Root Rot Disease in Noi Variety Grafted on Pai, a Resistant Mulberry Variety to the Disease

LAUAN BOONNAB and Takashi ISHIJIMA

One of the most destructive diseases of mulberry in Thailand is root-rot disease, which is rapidly spreading in many districts of the country at present. The causal agent of the disease has remained unknown, nevertheless many attempts have been repeatedly made to isolate microbes from infected mulberry trees. Effective countermeasures have not been established so far for controlling the disease.

ITOI *et al.*(2) found that Pai variety was highly resistant to the disease. On the basis of the fact, an expectation was naturally risen to prevent largely from the disease by utilizing Pai variety as a stock of other susceptible ones with better quality and yield of leaves. YAMAKAWA *et al.*(3) reported it might be available for the sericultural practices to protect mulberry from the disease in the field infested with the disease by planting a sapling grafted Noi as a scion on Pay as a stock.

We, however, found unexpectedly a high rate of occurrence of root rot disease in a field of young tree, Noi grafted on Pai stock.

MATERIAL AND METHOD

The ordinary field surveyed, where severe root rot disease of mulberry had occurred previously, was arranged for new planting, by digging out all stumps before plowing. A small part of the field was newly cultivated for enlargement of the field.

Noi, a susceptible variety to root rot disease, as a scion, was grafted on Pai, a resistant variety to the discase, as a stock. It was planted newly in the field above mentioned for a graft test in September, 1977. Planting distance was inter-row, 2.5 m and inter-tree, 0.75 m. The training type of mulberry was low cut with fist shape. Maintenance and manuring of the field were conducted in the usual practices of the Centre. Plants succeeded in grafting were monthly observed on the disease occurrence in the 2nd year of planting.

RESULTS AND DISCUSSION

No disease occurrence was recognized in the 1st year of planting. On 12 June 1978, in the 2nd year of planting, the initial occurrence of the root rot disease was recognized at a rate of about 9 percent. Thereafter the rate of the disease incidence began to increase highly with coming of the wet season, and attained in November the highest of 60.8 percent. The increasing tendency stopped perfectly with coming of the dry season (Table 1). This pattern of the disease incidence was same as in the previous paper(*1*).

However, no disease occurrence was observed in mulberry plants at the newly cultivated part of the same field, suggesting the high incidence of the disease originated by possible infection sources remaining in the field infested previously. No disease occurrence was observed in Pai plants as it stood without success in grafting.

The reason why a high incidence of the disease occurred in Noi variety grafted on Pai stock, (nevertheless the Pai itself was resistant,) should be clarified by further investigation. The high incidence within only two years after planting in Noi grafted on a resistant stock seems to cast a gloom over the future of utilizing resistant stocks as a means of controlling mulberry root rot disease. Therefore, more large scale experiments for many fields infested heavily with the disease will be required before its application to sericultural practices.

LITERATURE

(1) BOONNAB, L.· An observation on the occurrence of mulberry root rot in the infected field. Bul. Thai, Seri Pes. and Train Centre, No. 8, 1978

(2) ITOI, S. and L. BOONNAB: Root rot of mulberry in Thailand 2. Symptoms and varietal resistance of mulberry. Ibid. No. 4, 1974.

(3) YAMAKAWA, K. and M PANYAWANICH: An experiment on planting of mulberry saplings grafted by resistant variety to root rot disease in its infected field. Ibid. No. 8, 1978.

Table 1. Outbreak of root rot disease in Noi variety grafted on resistant Pai variety (1978)

Date of observation	Root rot disease occurrence	
	No. of diseased plant in new field	No of diseased plant (percent)
12 June	0	64 (9.4)
16 July	0	148 (21.4)
17 Aug.	0	235 (33.6)
18 Sept.	0	275 (39.7)
20 Oct.	0	411 (59.4)
22 Nov.	0	421 (60.8)
7 Feb. 1979	0	421 (60.8)

Note: 1. Total no of plant observed. 737 plants (45 in new field, and 692 in old field)
2. 15 unsuccessful Pai plants in grafting were all healthy.
3. Date of planting; Sept. 1977.
4. Middle cutting was done in March 1978.

42. Cooking Method of Low Quality Cocoons (2) Relation between Temperature and Reeling Efficiency

Chanya PANNENGPET, Vorapot RUKSUNG and Weera NARKKUM

Among cocoons shipped from farmers during rainy season, we can often find the cocoons with such as low reelability, inferior neatness and cleanness defects It is very important that these faulty cocoons should be handled to raise their reeling efficiency in the practices. In the previous report[1] the authors dealt with relation between cooking time and reeling efficiency.

This experiment was done to know the relationship between the temperature of retting part and the temperature of permeation part of cocoon cooking machine.

MATERIAL AND METHOD

1. This experiment was arranged by "split plot design, with main plots of the temperature of retting part, sub plots of the temperature of permeation part and 4 replications.

2. Cocoons used: K14xK1

3. Number of cocoons used: $9{,}600^{grams}$ ($200^{grams} \times 12^{treat.} \times 4$ rep.)

4 Reeling condition.

   (1) Cocoon cooking: By machine
   (2) Reeling machine: By multi-ends type.
   (3) Number of cocoons for a thread: 10
   (4) Number of reeling end: 5
   (5) Temperature of water in reeling basin: 40°C
   (6) Reeling speed: 90 m/min.

5. Temperature of retting part (sub plot)

   (1) 40°C (2) 55°C (3) 70°C

   High temperature of permeation part (sub plot)

   (1) 85°C (2) 90°C (3) 95°C (4) 100°C.

RESULT

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

From the statistically examined results, it may be said that every temperature of retting part and permeation part gave no different raw silk percentage, though reelability percentage was different among treatments.

From Table 4, it may be pointed out that cocoons with low reelability could result in raising up their reelabilities under 40°C of retting part and 100°C of permeation part.

LITERATURE

(1) PANNENGPET, C., V. RUKSUNG and W. NARKKUM: Cooking method of low quality cocoons (1) Relation between cooking time and reeling efficiency. Bul. Thai Seri. Res and Train. Centre, No. 8, 1978.

Table 1. Reelability (%)

Main plot	Sub plot	Replication				Average
		1	2	3	4	
40°C	1 85°C	51	51	53	48	51
	2. 90	53	50	48	50	50
	3. 95	58	49	56	55	55
	4 100	60	60	59	52	58
	Average	56	53	54	51	54
55°C	1. 85°C	50	51	48	47	49
	2. 90	53	48	56	56	53
	3. 95	48	48	51	49	49
	4. 100	51	51	50	57	52
	Average	51	50	51	52	51
70°C	1. 85	46	47	53	41	47
	2. 90	52	45	52	47	49
	3. 95	47	56	51	49	51
	4. 100	49	52	52	53	52
	Average	49	50	52	48	50

Table 2. Raw silk (%)

Main plot	Sub plot	Replication				Average
		1	2	3	4	
40°C	1. 85°C	13.25	13.76	14.05	14.77	13.96
	2. 90	14.64	14.14	14.39	13.65	14.21
	3. 95	15.02	13.86	14.21	14.98	14.52
	4. 100	14.57	13.90	14.98	14.72	14.54
	Average	14.37	13.92	14.41	14.53	14.31
55°C	1. 85°C	14.78	14.26	14.37	13.73	14.29
	2. 90	14.37	13.32	14.08	13.72	13.87
	3. 95	14 04	13.61	13.76	14.08	13.87
	4. 100	14.71	14.20	14.38	13.88	14.29
	Average	14.39	13.85	14.15	13.85	14 08
70°C	1. 85°C	13.42	14.39	13 75	14.59	14.04
	2. 90	14.30	13.76	13.74	13.66	13.87
	3. 95	14.22	13.65	14.12	14.50	14.12
	4. 100	14.24	13.79	13.88	14 53	14.11
	Average	14.05	13.90	13.87	14.32	14.04

Table 3. Analysis of variance

SV	df	Mean squares	
		reelability %	raw silk %
Replication	3	10.4097	0 3904
Temperature of retting part (A)	2	59.6458*	0.3380^{ns}
Error (a)	6	11.9514	0.2118
High temperature of permeation part (B)	3	50.8542**	0.2363^{ns}
A X B	6	17.8958^{ns}	0.1804^{ns}
Error (b)	27	9.8634	0.1667
CV (a) %		6.7	3.2
CV (b) %		6.1	2.8

Table 4. Table of means

Treatment	Reelability %	DMRT	Raw silk %	DMRT
Temperature of retting part				
40°C	53.3	a	14.3	a
55	50.9	ab	14.1	a
70	49.5	b	14.0	a
High temperature of permeation part				
85°C	48.8	b	14.1	a
90	50.8	b	14.0	a
95	51.4	ab	14.2	a
100	53.8	a	14.3	a

43. Study on Relation between Reeling Velocity and Size Deviation of Raw Silk, Using a New Automatic Reeling Machine, KEINAN type

Chanya PANNENGPET, and Saengchan KUN-OWN

Last April (1978), the automatic reeling machine, KEINAN type was set up in our Centre. It is very important to know the efficiency of raw silk reeling in the practical use of this machine in order to meet the needs of silk reeling industry.

In this experiment the authors tried to learn the relation between reeling velocity and size deviation of raw silk.

MATERIAL AND METHOD

1.	Form of experiment	:	Randomized Complete Blocks (R.C.B.) with 4 treatments, 5 replications.
2.	Cocoons used	.	K14xK1 race
3.	Reeling velocity tested	:	140, 160, 180, and 200 rounds/min.
4.	Number of cocoons	·	$6{,}000^{\text{grains}}$ ($300^{\text{grains}} \times 4^{\text{treatments}} \times 5$ replications)
5.	Reeling condition		
	(1) Cocoon cooking	.	By machine
	(2) Reeling machine	:	By automatic reeling machine, KEINAN type.
	(3) Number of reeling end	:	10
6.	Size test	:	80 (16 skeins X 1 treatment x 5 replications) sample sizing skeins.

RESULT

Results are shown in Tables 1, 2 and 3.

From the statistically examined results there was no significant difference among 4 treatments with the respective reeling velocity. It may be said that the size of raw silk could be hardly affected by the above reeling velocities.

Table 1. Average size and standard deviation of raw silk (denier)

Velocity	Replication					Average
	1	2	3	4	5	
140r/min.	19.31 (0.883)	18.39 (1.008)	18.87 (1.110)	18.87 (0.991)	19.09 (0.999)	18.89 (0.998)
160	19.52 (0.756)	17.81 (0.544)	18.48 (1.082)	18.83 (1.019)	17.69 (0.772)	18 47 (0.835)
180	19.14 (0.774)	18.38 (0.736)	19.53 (1.347)	19.20 (1.009)	18.84 (1.110)	19.02 (0.995)
200	18.38 (1.065)	18.78 (1.255)	18.94 (1.112)	18.38 (2.345)	18.69 (1.051)	18.63 (1.366)

Note: ( ) Shows "standard deviation".

Table 2. Analysis of variance

SV	df	SS	MS	F
Replication	4	22.7629	5.6907	
Treatment	3	14.9570	4.9857	1.60^{ns}
Error	12	37.3184	3.1099	
Sampling error	300	366.9609	1.2232	

CV = 9.4%

Table 3. Table of means and standard deviation (denier)

Treatment	Mean	Standard deviation
Velocity		
140r/min.	18.89 a	1.02
160	18.47 a	1.08
180	19.02 a	1.07
200	18.63 a	1.43

44. Study on Relation of Reeling Velocity to Tenacity and Elongation of Raw Silk, Using a New Automatic Reeling Machine, KEINAN Type

Chanya PANNENGPET, Konthawirat CHOMCHUEN and Prayad TENGRATANAPRASERT

As reeling velocity has close relation to the efficiency of machine and the quality of raw silk, the successive experiment (1) was performed to get the basic knowledge of tenacity and elongation of raw silk which is concerned with reeling velocity, using a new automatic reeling machine, KEINAN type, set up in last April.

MATERIAL AND METHOD

1.	Type of experiment	:	Randomized Complete Block design (R.C.B.)
2.	Cocoons used	:	K14xK1
3.	Reeling conditions		
	(1) Cocoon cooking	.	by machine
	(2) Reeling velocity	:	140, 160, 180 and 200/min, with the respective 5 replications.
	(3) Number of reeling end	:	10
	(4) Number of cocoons used	·	6,000 grains (300 grains x 4 treatments x 5 replications.)
4.	Sample for test of tenacity and elongation	'	80 ($16^{skeins} \times 1^{treatment} \times 5^{replications}$) sample sizing skeins.

RESULT

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

The statistically examined results showed no sifnificant difference among 4 treatments for tenacity and elongation of the resulting raw silks.

So that, the automatic reeling machine, KEINAN type, might be available for reeling with velocity each given under the above conditions.

LITERATURE

(1) PANNENGPET, C., S. KUN-OWN, and P. TENGRATANAPRASERT: Relation between the reeling velocity, and the strength and degree of elongation of raw silk. Bul. Thai Seri Rec. and Train. Centre No. 8, 1978.

Table 1. Tenacity (gr/d)

Reeling velocity (round/min)	Replacation					Average
	1	2	3	4	5	
140	3.38	3.42	3.43	3.48	3.51	3.44
160	3 49	3.40	3.47	3.57	3.44	3.47
180	3.40	3.40	3.53	3.60	3.51	3.49
200	3.46	3.37	3.50	3.63	3 46	3.48

Table 2. Elongation (%)

Reeling velocity (round/min.)	Replication					Average
	1	2	3	4	5	
140	18.38	21.44	23.01	21.06	22.60	21.30
160	20.81	22.36	23 01	22.45	23 64	22.46
180	22.58	20.17	22.07	22.04	21.09	21.59
200	23.61	22.06	23.17	23.31	22.77	22.78

Table 3. ANOV for tenacity and elongation

SV	df	Mean squares	
		Tenacity	Elongation
Replication	4	0.2587	25.7467
Treatment	3	0.0275^{ns}	39.4866^{ns}
Error	12	0.0324	21.9952
Sampling error	300	0.0253	3.8348
CV %		5.1	21.2

Table 4. Table of means and standard deviations

Treatment	Tenacity		Elongation	
	mean	standard deviation	mean	standard deviation
Velocity (round/min.)				
140	3 45	0 18	21.30	2.86
160	3.47	0.14	22.46	1.96
180	3.49	0.15	21.59	2.05
200	3.48	0.20	22.78	1.73

45. Reeling Survey on the Cocoon of Different Varieties of Silkworm in 1978

Saengchan KUN-OWN and Chanya PANNENGPET

As in 1977[1] reeling survey was done to judge the quality of cocoons produced by different strains of silkworms under breeding in the Centre, in order to obtain the data available to select better strains of silkworms.

MATERIALS

Cocoons tested were produced in June, August and October 1978.

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

METHOD OF REELING

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

RESULTS

Results are shown in Tables 1, 2 and 3.

(Note: The percentages of raw silk in the tables show that of fresh cocoon.)

(1) Reeling of cocoons produced in June is summarized in Table 1.
Among the cocoons of 7 silkworm varieties, a double cross, (K1xT) x (K6xK18) showed better characters than those of the other races.

(2) Reeling of cocoons produced in August is summarized in Table 2.
Among the cocoons of 8 F_1 hybrids, K6xK8 and K6xK14 showed better characters, especially in the raw silk percentage, than other races.

(3) Reeling of cocoons produced in October is summarized in Table 3.
Among the cocoons of 7 F_1 hybrids, A8xK18 showed worse character, especially in the raw silk percentage, than the other races

LITERATURE

(1) KUN-OWN, S. and C PANNENGPET. Reeling survey on the cocoon of different varieties of silkworm in 1977. Bul. Thai Seri. Res. and Train. Centre. No. 8, 1978

Table 1. Reeling of cocoons produced in June, 1978

Race	Length of cocoon filament (m)	Weight of cocoon filament (cg)	Size of cocoon filament (d)	Reelability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)
K1xK8	939	20.60	2.0	60	14.2	20.7	69
K1xE28	944	22 74	2.2	63	13.7	18.7	73
K6xK8	1,123	29.37	2.5	47	16 1	18.7	75
$(K1xK18)_2$	819	19 23	2.1	79	13.7	19.2	71
(K1.T)x (K6.K18)	869	27 69	2.9	58	17.3	19.3	90
(6.T)x (K1.K18)	819	21.77	2.5	50	12.5	18.8	66
(K14.T)x (K6.K1)	943	24.43	2.4	61	14.5	18.9	77

Table 2. Reeling of cocoons produced in August, 1978

Race	Length of cocoon filament (m)	Weight of cocoon filament (cg)	Size of cocoon filament (d)	Reelability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)
K1xK8	1,103	22.48	1.8	84	14.5	19.4	75
K1xK14	1,046	23.10	1.9	83	14.9	19.6	76
K1xK16	1,083	22.94	1.9	89	15.3	19.3	79
K1xK18	966	20.30	1.9	89	15.2	20.6	74
E28xK1	1,088	21 89	1.8	76	15.4	20.1	77
K6xK8	1,027	17 15	2 2	88	17.2	21.6	80
K6xK14	1,044	27.01	2.3	87	17.3	20.8	83
K6xK16	979	26.80	2.5	81	16.8	20.9	80

Table 3 Reeling of cocoons produced in October, 1978

Race	Length of cocoon filament (m)	Weight of cocoon filament (cg)	Size of cocoon filament (d)	Reelability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)
A8xK8	1,154	28.03	2 2	57	16.2	21.3	76
A8xK16	1,056	27.53	2.4	86	15.9	20.6	77
A8xK18	1,023	26.30	2.3	61	14.9	21.0	71
C2xN2	1,053	29 40	2.6	85	16.9	22.0	77
N2xC2	1,002	29.69	2 7	83	18.5	23.0	80
N2xK8	1,027	27.51	2.4	88	15 9	21 2	75
KxS	1,048	31.06	2.7	89	16.6	22 5	74

46. Result of Test Reeling of Cocoons Produced by Farmers in 1978

Konthawirat CHOMCHUEN and Chanya PANNENGPET

In the year 1978, our Centre purchased the cocoons from many farmers in several districts of Thailand (Tables 1 and 2). Most of these cocoons were produced from eggs supplied to them by the Centre and Stations. They were estimated on the quality by test reeling in our laboratory, taking at random 600 cocoons per lot as a sample, dividing them into two equal numbers in order to repeat the test reeling as the same way as in last year[1].

METHOD

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

RESULT

The results are shown in Tables 1 and 2.

In this year, divided in two tables, the results were shown on the respective cocoons purchased by our Centre and each private silk company in Tables 1 and 2.

From the data (Table 1) it proved that the qualities of cocoons were considerably raised, compared with last year's results: That is to say, in this year, average raw silk percentage and length of cocoon filament were better and percentage of eliminated cocoons was lowered.

Additionally, it may be said that the quality of cocoon heavily depends on the rearing experience and technique of each farmer and environmental conditions (locality, climate, mulberry leaves, etc.), even if the same silkworm variety is reared. And also, in this year it was recognized that the amount of cocoons shipped to the Centre increased remarkably, renderred services to private silk companies to promote the Thai Silk industries (Table 2).

LITERATURE

(1) CHOMCHUEN, K. and C PANNENGPET. Result of test reeling of cocoons produced by farmers in 1977, Bul. Thai Seri. Res. and Train. Centre, No. 8, 1978.

Table 1. Result of test reeling (Center) (1978)

No.	Locality	Shipping date	Race	Shipping amount, fresh cocoon (kg)	Length of cocoon filament (m)	Size of cocoon filament (d)	Reelability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)	Eliminated cocoon (%)
1.	Kuchinarai	7 June	K1×K14	81.10	1,186	2.2	45	14.46	19 75	73	24.40
	Kuchinarai	25 July	K14×K1	611.30	1,314	2 1	47	12.99	21.00	62	8 47
2	Chiengpin	10 Sept.	Imported	461.20	1,156	2.2	63	14.61	22.24	66	13.11
	Chiengpin	10 Nov.	egg	313.10	1,118	2.2	81	15.01	21.56	70	4.46
	Chiengpin	26 Dec.	K1×K8	99.80	978	1.8	95	14.45	17.86	81	22.81
3.	Bangruad	11 Sept.	Imported egg	169.40	1,135	2.5	85	16.68	22.91	73	16.95
	Bangruad	22 Dec.	K1×K8	136.30	1,160	1.9	82	14.63	19.14	76	7.14
4.	Ubol-Rat	10 June	K1×K14	388 20	995	1.9	67	15.47	21.38	72	16.39
5.	Lumdomnoi	13 Feb.	K1×K14	66 10	1,116	2.1	61	15.70	20.73	76	3 17
	Lumdomnoi	26 Dec.	K1×K8	344.60	1,116	1.7	88	15.60	19.17	81	22.77
6.	Lumdomyai	21 Dec.	K1×K8	218 00	1,012	1.8	85	13.24	17.83	74	10.21
7.	Prasart	9 March	K1×K14	377 30	–	–	–	–	19.44	–	6.58
	Prasart	7 June	K1×K8 K1xK14 K14×K1	590.30	1,207	2.0	77	15.57	20.30	77	5 91
	Prasart	26 July	K1×K14	957.60	1,048	2.0	67	15.09	19 57	77	5 34
	Prasart	11 Sept	Imported egg	108.50	1,293	2.5	65	17.14	23.47	73	14.10
8	Ponpisai	11 Sept.	Imported egg	338.80	1,108	2.4	57	15.07	22 17	68	17 03
	Ponpisai	12 Nov.	Imported egg	514.30	1,116	2 3	70	16.44	21.31	77	3.96
	Ponpisai	26 Dec.	K1xK8	78.20	1,173	1.9	78	15.60	19.43	80	19.54
9.	Kabinburi	13 Aug.	–	210.50	1,324	2.5	53	16.90	23 38	72	8 59
	Kabinburi	31 Oct.	–	336.60	1,288	2.4	70	18.47	22.46	82	14.54
	Kabinburi	20 Dec.	–	165.90	977	2.0	95	17.07	21.04	81	14 72
10.	Karbcherng	21 Aug	K8×K1	258.20	989	2.1	63	13.40	19.01	71	7.75
11	Korat	17 Feb.	K1×K14	41.10	840	1.8	73	13.72	19.30	71	13.20
	Korat	24 Oct.	K14xK1	44.20	958	1.7	79	14.52	19 63	74	33 00
Total or average in 1978				6,910.60 (5,676.80)	1,113 (942)	2.09 (1.8)	71.56 (75.20)	15.30 (14 29)	20.59 –	74 –	13 08 (21 94)

Note: ( ) shows the figures of last year.

Table 2. Result of test reeling (Company) (1978)

No.	Locality	Shipping date	Race	Shipping amount fresh cocoon (kg)	Length of cocoon filament (m)	Size of cocoon filament (d)	Reelability (%)	Raw silk (%)	Cocoon shell (%)	Raw silk percentage of cocoon shell (%)	Eliminated cocoon ((%)
1.	Kuchinarai	16 Feb.	K1xK8	162.10	1,088	2.0	77	15 32	20.00	77	9.21
	Kuchinarai	8 Sept.	Imported egg	1,244.00	–	–	–	–	22.92	–	14.59
	Kuchinarai	22 Nov.	K8xK1	722.90	959	1.8	89	14.10	19.00	74	6.98
2.	Chiengpin	16 Feb	K8xK1	82 30	1,098	2.1	77	17 00	20.82	82	3.24
3.	Bangruad	16 Feb.	K1xK14	225.50	784	1.7	82	13.59	18.29	74	15.81
4.	Ubol-Rat	16 Feb.	K1xK14	319 60	1,160	2.0	81	16.71	21.59	77	6.09
	Ubol-Rat	6 Sept.	K1xK14	986.90	927	1.8	68	11.31	17.00	67	11.46
	Ubol-Rat	26 Oct.	K1xK8	1,298.20	798	1.8	81	13.00	18.69	70	12.85
	Ubon-Rat	20 Dec.	K1xK8	843.80	854	1.5	90	12 20	17.00	72	14.32
5.	Pimai	8 March	Imported egg	582.00	–	–	–	–	–	–	–
	Pimai	8 June	Imported egg	829.00	–	–	–	–	24.21	–	–
	Pimai	20 June	"	636.10	1,337	2.1	68	17.45	23.59	74	–
	Pimai	27 Sept.	"	1,319.20	1,041	2.3	82	15.17	–	–	–
	Pimai	14 Nov.	"	1,222.90	1,334	2.3	79	17.28	22.98	75	–
	Pimai	20 Dec	"	627.80	1,063	1.8	92	14.62	–	–	–
6.	Lumdomnoi	26 June	K1xK14	256.60	1,082	1.8	47	13.25	19.03	70	14.88
	Lumdomnoi	2 Aug.	K1xK14	109.10	945	2.0	50	12.40	18.08	69	12.64
	Lumdomnoi	11 Sept.	Imported egg	346.90	1,001	2.3	73	16.00	21.69	74	20.25
	Lumdomnoi	9 Nov.	"	303.40	1,206	2.3	73	16.22	21.02	77	6.96
7.	Lumdomyai	27 June	K1xK14	198 90	1,005	1.8	49	11.69	18.00	65	19 11
	Lumdomyai	3 Aug.	K1xK14	245 50	879	2.3	58	11.91	18 08	66	6.93
	Lumdomyai	9 Sept	Imported egg	327.90	1,102	2.5	41	13 43	21.05	69	11.02
	Lumdomyai	10 Nov.	"	191.50	–	–	–	–	21.21	–	7.62
8.	Lampao	12 Nov.	"	667.50	1,149	2.1	70	15.00	21.24	71	6.01
	Lampao	25 Dec.	K1xK8	280.00	963	1.7	90	13.21	17.00	78	14.20
9.	Kumsoi	13 Nov.	Imported egg	997 20	1,173	2.2	67	16.35	21.00	78	4.02
Total or average –				13,707 60	1,029	2.01	72	14.32	20.15	73	10.91

47. Survey on Relation between Size of Raw Silk and Graduations on the Adjusting Scale Plate, Using a New Automatic Reeling Machine, KEINAN Type

Kesato YAMAGUCHI, Saengchan KUN-OWN and Chanya PANNENGPET

A new automatic reeling machine, KEINAN type was set up in our Centre last April, 1978. Size detector and size adjusting apparatus, acting in cooperation with picking cocoon equipment, are the most important parts of the automatic reeling machine in order to maintain the proposed size of the thread throughout the reeling process. Each detector is attached, with the control rod, to size adjusting apparatus to help accurately the performance of the detector.

The experiment, using cocoons cooked in the same manner, was started to know relation between size of raw silk to have its uniformity and graduations on the adjusting scale plate to be adjusted and inspected periodically, under different reeling velocities.

MATERIAL AND METHOD

1.	Cocoons used:		K1xK14 (size: 1.67 denier)
2.	Cocoon cooking	:	By cooking machine as usual.
3.	Cooking time	:	10 minutes/lot
4.	Reeling machine	:	Automatic reeling machine, KEINAN S-EB type
5.	Reeling velocity	:	100, 125, 150, 175, and 200 round/minute
6.	Time of reeling	:	40 min./lot
7.	Graduations on the adjusting scale plate to be arranged	:	+6, +4, +2, 0, −2, −4, −6
8.	Target size	:	21 deniers
9.	Size test	.	50 sizing skeins/lot

Trials were at ramdom carried out under the respective combination of the reeling velocity at 5 levels and the graduations at 7 levels

RESULT AND CONSIDERATION

Results are shown in Table 1 and Figs 1–3.

1 Size of raw silk (Table 1)

From the statistically examined data, the sizing skeins showed highly significant difference among the reeling velocities and the graduations on the adjusting scale plate to be adjusted, respectively. Namely, in case the graduations of the scale plate were fixed, the expected size became finer with the increasing reeling velocity, and in the case of constant reeling velocity, the expected size became finer with the graduations moving +6 to -6. Accordingly, it is desirable to use effectively the scale plate to help size detector's movement.

2. Standard deviation of size of raw silk (Table 1 and Figs. 1–2.)

From the statistically examined data, the standard deviation of sizing skeins in the size test showed highly significant difference among the graduations on the scale plate to be adjusted, showing a trend to level off near +2 and 0 points, while it was hardly affected by different reeling velocities.

3. Relation between the proposed size of raw silk to be reeled and the graduations on the adjusting scale plate is illustrated in Fig. 3. According to Fig. 3, we can easily read that the graduations may be fixed at +1 point, in case the raw silk with the proposed size, 21 deniers, is to be reeled with reeling velocity, 200r/m.

In addition, there are many factors, for example, such as filament size of cocoon to be reeled, degree of cooking, and reeling velocity, which give changeable variations to the expected size of raw silk. It is very necessary to pursue the interaction of cause and effect among them, followed by proper maintenance of the detector.

Table 1. Size of raw silk and its standard deviation

a Scale plate
b Item
c Reeling velocity

a	b \ c	100r/min d	125r/min d	150r/min d	175r/min d	200r/min d	Average d	Analysis of variance
+6	Size	24.05	23.25	23.68	23.17	22.89	23.41	Size F (0.01)** Standard deviation F (0.01)**
	Standard deviation	1.299	1.906	1.008	1.348	1.031	1.318	
+4	Size	23.60	23.09	23.22	22.62	22.50	23.01	
	S. D.	1.399	0.977	1.192	1.510	1.011	1.218	
+2	Size	23.45	22.50	22.55	21.47	20.92	22.18	
	S. D	1.165	1.140	1.400	1.018	1.311	1.207	
0	Size	21.95	21.06	21.82	20.41	20 37	21.12	
	S D.	1.284	1.194	1.280	1.117	1.336	1.242	
-2	Size	20.47	20.33	20.28	19.03	18.97	19.81	
	S. D.	1.356	1.521	2.117	1.057	1.345	1.479	
-4	Size	18.86	18 99	17.87	17.47	17.41	18.12	
	S. D.	1.952	1.538	1.336	2.272	1 631	1.746	
-6	Size	16.95	16.32	16.35	15.98	14.81	16.08	
	S. D.	1.644	1.647	1 711	1.527	2.221	1.750	
Average	Size	21.33	20.79	20.82	20.02	19.70	20.53	
	S. D.	1.443	1.418	1.435	1.407	1.412	1.423	
Analysis of variance		Size F (0.01) ** Standard deviation F (0.05)^{ns}						

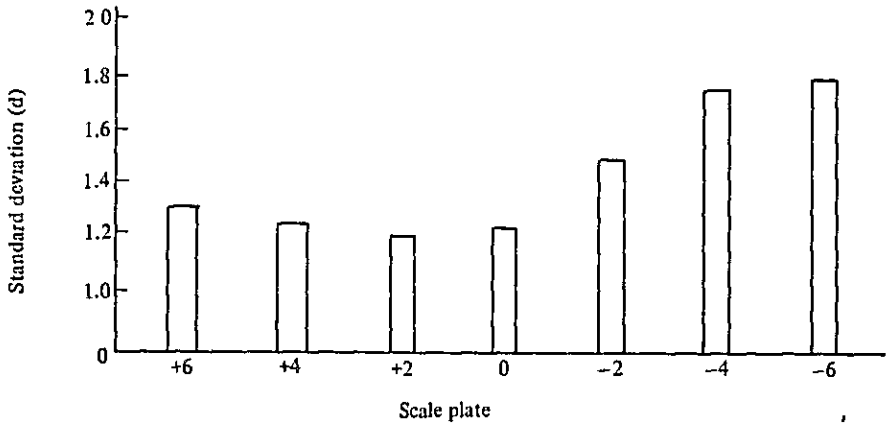

Fig. 1. Relation between the graduation and standard deviation of sizing skeins.

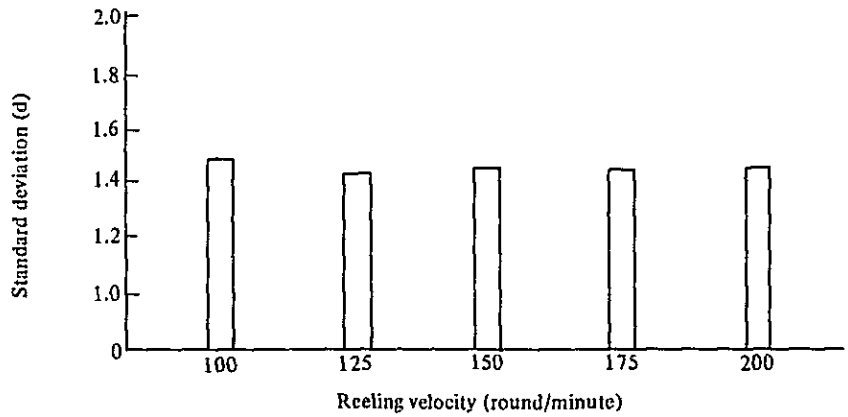

Fig. 2. Relation between the reeling velocities and standard deviation of sizing skeing.

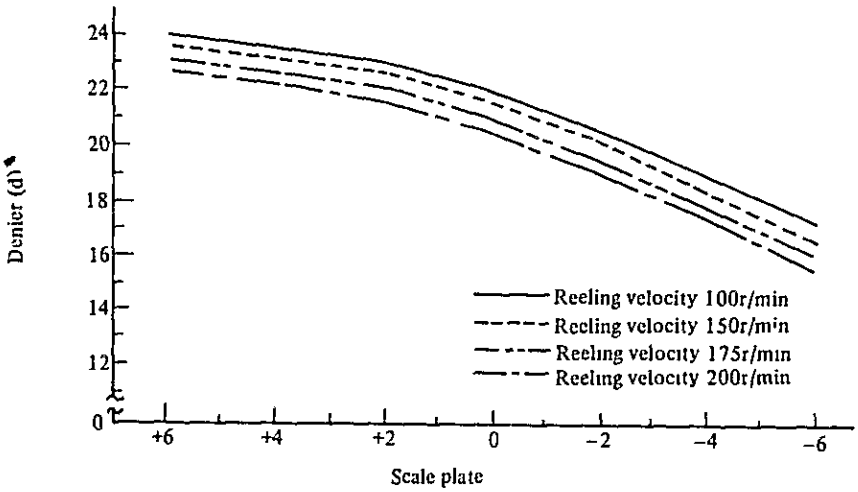

Fig. 3. Relation between size (denier unit) and graduation on the denier guage under different reeling velocities.