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Studies on Silkworm Selection by Use of Anesthetic(2)

(The Eeffct for next Generation through Anesthesia)

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麻醉劑處理에 의한 蠶兒選拔 硏究 (2)

(麻醉蠶의 次代에 미치는 影響)

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摘 要

本報告는 麻醉劑 處理에 의한 蠶兒選拔에 對한 硏究의 第二報이며 麻醉回生速度差異가 蠶兒의 强健性과 關連性이 있는지의 與否를 多角度로 分析하기에 이르렀다.

麻醉回生速度 差異가 蠶兒 强健性과 密接한 關係가 있음을 알고 育種時의 蠶兒選拔과 原蠶種製造時의 品質保存의 目的으로 使用하기 爲하여 Balance Health (BH)價를 設定하여 選拔目標의 標準을 設定함에 이르렀다.

또한 當代麻醉處理로 因하여 次代에 미치는 影響을 調査하기 爲하여 P_1과 F_1의 繭質調査를 하여 다음과 같은 結論에 이르렀다.

1. 基礎調査 結果

a) 交雜種은 原種보다 强健한 탓으로 麻醉의 回生이 빨랐다.

b) 强健性品種은 虛弱性品種보다 麻醉回生이 빨랐다.

c) 雄蠶은 雌蠶보다 强健한 탓으로 麻醉回性이 빨랐다.

2. Balance Health (BH)價의 設定

麻醉處理에 의하여 區分된 母蠶의 交配區의 區分을 明確히 하여 選拔目標를 確立하기 爲하여 이것을 다음과 같이 規定하였다.

웅 \ 우	1	2	3
1	BH 2	BH 3	BH 4
2	BH 3	BH 4	BH 5
3	BH 4	BH 5	BH 6

단
1은 麻醉回生이 빠른것
2는 麻醉回生이 中間인것
3은 麻醉回生이 늦은것

3. 蠶兒育種時에 選拔效果를 能率化하기 爲하여 BH價 使用을 强調하며, BH價가 4 보다 작은 것을 택할때는 强健性選拔이 되고 4 보다 큰것을 택할때는 虛弱性選拔이 되는 事實을 알았다.

4. 一旦 麻醉處理한 母蠶에서도 次代 即 P_1이나 F_1에 아무런 惡影響을 미치지 않고 母蠶의 BH 價 分類效果가 次代에 反映되고 있었다.

5. 原種製造 過程에서도 麻醉處理의 選拔을 함으로서 蠶種의 均一化를 圖謀하고 品種의 退化時期를 延長시킬수 있다고 본다.

6. 蠶兒育種 選拔時에는 五齡期에 5分間 麻醉處理하고 原種製造時에는 5齡期에 2.5分間 處

理하는 것이 좋다고 보았다.

7. 本報는 蠶業增産에 關連된 問題를다루었으나 麻醉處理가 蠶體生理에 미치는 學術的인 硏究課題가 많이 남아있다고 본다.

I. Introduction

The author had observed and analysed the recovery distribution from nacorsis to see if it may be useful for better homogenesis selection on silkworm pure line production in the previous report.

Through such a study, he has found that it may be also useful for genetical breeding service. For this purpose, the author has started out of it all over again, nacortizing worms at the chance of first mulberry feeding in fifth instar to see the recovery distribution form through,

(a) compraation between pure line and their hybrid,

(b) comparation between strong and weak varieties,

(c) comparation between male and female larbae.

The observation was continued to see how such nacortized parents affect to their family by checking P_1 and F_1 of them. This will acknowledge that the staff member of national sericultural experiment station, Mr. Yong Il Mah and Hae Yong Son have cooperated with the project. Some part of necessary fund for the work was sponsered by Seoul National University Research Foundation.

II. Materials and Methods.

In order to make sure if ether nacorsis with silkworms work as health evaluation, he has compared by three different directions as followings,

(a) nacorsis recovery distribution against silkworm variety ···used S103P, S104P, S103×S104

(b) nacorsis recovery distribution against silkworm health ···GR27(strong variety), E27(weak variety)

(c) nacorsis recovery distribution against silkworm sexes ···W^{+P}/Z(sex limited variety)

The recovery distribution was investigated by counting the number of silkworms adapting mulberry leaves at every five minutes after nacortized for 2.5 minutes and five minutes. Mean time, the number of silkworm missing until cocooning was also inverstigated to evaluate each group health. Because of each variety has different growong histroy, the nacorsis has applied at the first mulberry feeding chance of fifth instar.

After harvest of each group cocoon, they were used to produce silkworm eggs to see how affect to their P_1 and F_1. In case produce of silkworm eggs for P_1 and F_1, the sample worms are classified as early recovered group, medium recovered group and late recovered group. These groups are specified as 1, 2 and 3. For the identification of each produced group for the next generation, this report prepared a new system as following chart,

(a) in case of P_1 investigation

♀ \ ♂	1	2	3
1	P'_2	P'_3	P'_4
2	P'_3	P'_4	P'_5
3	P'_4	P'_5	P'_6

1. ·····early recovered group
2. ·····medium recovered group
3. ·····late recovered group

With three different group of parents from both female and male, we can produce nine different types of P_1 by what we call diagonal crossing method. The foot number of each group shows the added number concerned the parent identification. These nine groups are regrouped as three large groups like as $P'<4$ (P'2, P'3), $P'=4$ and $P'>4$ (P'5, P'6)

(b) in case of F_1 investigation

$S104^P$ \ $S103^P$	1	2	3
1	C_2	C_3	C_4
2	C_3	C_4	C_5
3	C_4	C_5	C_6

In this case, C represents hybrid cross but other things are the same with the above statement.

The author, however, has found some complication to discuss the working result with the above statement from technical aspect. So he has decided to use an unified name for the system such as Balance Health value regardless breeding service or pure line produ-

ction. In case of BH<4, this will represent strong group worms, BH=4 will be medium group and BH>4 will be weak group. We can also discuss any specific BH value group like as BH=2 or 5, if it is necessary by inducing such a nameing. Another word, BH is defined to identify produced eggs after nacorsis classification with parent silkworms. Then, we can locate or identify easily any produced egg with BH value indication.

III. Results and Discussion

1. Basic investigation

The discussion about the mechanism of nacorsis on silkworm has been carried out in the previous report.[1] There was an arguement with the previous report about health evaluation. The previous report showed female worms recovered from nacorsis earlyer than male worms in spite of fact the former is recognized as weaker than the latter. This would be against wth the hypothesis which healthy worms recover from nacorsis earlyer than weak worms.

Such question was cleared with this report as shown in Table 3. The table shows female worms recover from nacorsis later than male worms at 2.5 minutes ether induction, but it recovers earlyer than male worm at 5.0 minutes induction.

When we look over from Table 1 to 3, it is very clear that healthy worms recover from nacorsis than the others, but the difference between sexes shows smaller difference than other comparation, which explains it may have possibility of transition recovery. Also it should be beared in mind that there are some exception who do not follow the health evaluation by such nacorsis.

The following three tables show the following conclusions.

(a) Hybrid variety recovers from nacorsis earlyer than pure line because it is stronger.(see Table 1)

(b) Strong variety recovers from nacorsis earlyer than weak variety because it is stronger.(see Table 2)

(c) Male worm recovers from nacorsis earlyer than female worm because it is stronger.(see Table 3)

Table 1. Nacorsis revovery distribution against silkworm varieties

nacortized	2.5 min								5.0 min							
recovered(min)	5	10	15	20	25	30	ave	worm missing	5	10	15	20	25	30	ave	worm missing
	%	%	%	%	%	%		%	%	%	%	%	%	%		%
S103P(Jap)	42	23	17	···	4	14	12′ 9″	18	10	27	23	15	25	···	15′ 14″	58
S104P(Cha)	24	32	14	22	8	···	12′ 54″	28	···	47	41	10	2	···	13′ 21″	54
S103×104	79	25	···	···	4	···	6′ 39″	13	71	12	7	···	10	···	8′ 18″	15

Table 2. Nacorsis recovery distribution against silkworm health

nacortized	2.5 min									5.0 min									
recovered (min)	5	10	15	20	25	30	35	ave	worm missing	5	10	15	20	25	30	35	40	ave	worm missing
	%	%	%	%	%	%	%		%	%	%	%	%	%	%	%	%		%
strong var. (GR 27)	74	25	···	···	···	···	1	6′ 33″	2	12	10	16	27	20	15	···	···	18′54″	32
weak var. (E 27)	12	26	26	12	6	10	8	16′48″	52	···	6	10	8	6	22	16	10	21′24″	49

Table 3. Nacorsis recovery distribution against silkworm sexes (W^{+p}/Z)

nacortized	2.5 min							5.0 min						
recovered(min)	5	10	15	20	25	ave	worm missing	5	10	15	20	25	ave	worm missing
	%	%	%	%	%		%	%	%	%	%	%		%
female	10	67	21	2	···	10′ 45″	36	29	55	14	···	2	19′ 33″	20
male	34	62	2	···	2	8′ 42″	30	32	42	22	4	···	19′ 54″	10

When we see about silkworm missing ratio, the stronger one shows less missing ratio during its growing period. One thing we have to realize, is the silkworm missing ratio of each group shows fairly poor result than normal rearing case. It is deemed that such results are come from some latent weakness which is exposed out through nacorsis. There is no trouble with such missing ratio in the process of silkworm breeding or production of pure line worm because such latent weakness will be exposed out in their future generation and bring about retrograde phenormenon.

This means that we can delay retrograde of silkworm variety by using such nacortizing method in the process of pure line production

In case extend the nacortizing period, the recovery is delayed and shows more wider distribution. It would be better to use 5.0 minutes application for breeding service, but 2.5 minutes nacorsis for pure line production. The silkworm missing ratio is also increased with the treat extension.

Other basic investigations like as pupa weight and cocoon shell percentage are eliminated from this paper because these were discussed in the previous report. This paper shows only supplemental informations.

2. P_1 cocoon quality investigation produced from nacontized parents.

In order to see how once nacortized parents affect to their family, P_1 was prepared from the eggs of treated parents.

As it is shown in Table 4, there is no much change as average in each variety, but there is some difference between BH value analyses. In case of BH value is smaller than four, the cocoon nature shows better result than the Control. On the other hand, the table shows poor result in case BH value is four or more than that value.

This result explains that we will be able to use BH value analysis during the parent life cycle so that we can produce better homogeneous silkworm for pure line production. The non breaking reelable ratio seems to drop down by the nacorsis of parents, but this result is come from the improving result of cocoon bave length than the Control. If we push up the silk yield of each variety by such nacorsis method, this will bring about the delaying of retrograde which we may use one variety for many years than non treated case.

Table 4. P_1 cocoon qualities from nacortized parents

group \ item	cocoon bave length	cocoon bave size	non breaking bave length	non breaking reelable ratio	silk percent per cocoon
$103P_1$ Control	939m	2.37d	746m	80%	15.54%
$103P_1$ BH<4	1,085	2.26	801	74	16.10
$103P_1$ BH=4	929	2.49	721	78	15.93
$103P_1$ BH>4	955	2.47	734	77	16.07
$104P_1$ Control	958	2.21	734	77	15.32
$104P_1$ BH<4	1,057	2.07	749	71	16.12
$104P_1$ BH=4	1,005	2.17	683	68	15.91
$104P_1$ BH>4	1,028	2.14	745	73	15.64

3. Hybrid cocoon quality investigation produced by nacortized pure line.

The final goal of silkworm breeding is of course to produce better commercial cocoon for silk reeling service.

The cocoon shell per cent of hybrid should be considered as an important matter to compare the work result. Table 5 shows the cocoon shell per cent distribution for the produced cocoon from nacortized pure lines, $S103P_1$ and $S104P_1$. In case BH value is smaller than four, the result also shows better cocoon shell per cent than the Control. The deviation of it also shows better result in this case. But, in case BH value is four or larger than this, the cocoon shell per cent and its deviation get worser than the other

Table 5. F_1 cocoon shell per cent distribution from nacortized parents

group / cocoon shell %	CONT-ROL	group BH<4			group BH=4			group BN>4		
		BH 2	BH 3	BH 3	BH 4	BH 4	BH 4	BH 5	BH 5	BH 6
13%	—	—	—	—	—	—	—	1	—	—
14	—	—	—	—	1	—	—	1	2	—
15	1	—	—	1	0	1	—	1	1	1
16	5	6	2	2	2	1	1	2	2	5
17	8	7	6	5	14	7	7	9	7	8
18	7	6	7	7	5	12	8	6	11	9
19	6	6	4	8	4	6	7	9	4	4
20	2	4	8	2	6	6	4	4	3	2
21	8	3	7	5	5	4	10	8	3	8
22	5	7	6	12	5	6	10	5	8	5
23	4	3	5	5	4	2	2	2	5	6
24	1	2	0	0	1	3	0	1	2	0
25	1	6	4	3	3	0	0	1	1	0
26	1	—	—	—	—	0	0	—	0	0
27	1	—	—	—	—	1	0	—	0	1
28	—	—	—	—	—	1	0	—	1	—
29	—	—	—	—	—	—	0	—	—	—
30	—	—	—	—	—	—	1	—	—	—
n	50	50	50	50	50	50	50	50	50	50
$\bar{X}$	19.6	19.6	20.5	19.8	19.7	18.6	19.2	19.8	19.6	19.6
$S_{\bar{X}}$	2.96	2.96	2.43	2.52	2.68	2.93	3.38	2.56	2.58	2.96

Table 6, F_1 cocoon quality analysis from nacortized parents (P_1)

group / check items	CONT-ROL	group BH<4			group BH=4			group BH>4		
		BH 2	BH 3	BH 3	BH 4	BH 4	BH 4	BH 5	BH 5	BH 6
cocoon shell percent(%)	19.6	19.6	20.5	19.8	19.7	18.6	19.8	19.2	19.9	19.6
cocoon drying ratio(%)	41.0	42.5	42.3	41.8	41.6	41.5	41.9	42.8	42.2	41.7
cocoon assoting ratio(%)	8.0	2.7	1.7	8.1	2.3	7.5	10.6	14.7	12.5	9.9
cocoon bave length(m)	1,183	1,181	1,276	1,210	1,114	1,026	1,144	1,258	1,175	1,265
cocoon bave weight(cg)	35.7	34.2	39.0	38.7	34.9	31.1	35.4	36.2	35.8	36.6
cocoon bave size(d)	2.70	2.60	2.75	2.88	2.82	2.73	2.79	2.59	2.74	2.60
no. cocoon bave breaks per cocoon	1.28	1.20	1.26	1.38	1.35	1.18	1.26	1.42	1.31	1.23
non breaking bave length(m)	906	982	1,007	875	821	864	905	880	893	1,026
non breaking bave weight(cg)	27.7	28.4	30.8	28.0	25.0	26.2	28.0	25.3	27.2	29.7
non breaking reelable ratio(%)	78	83	80	73	74	85	79	70	76	82
silk per cent per cocoon(%)	16.27	16.42	16.51	16.60	16.28	15.83	16.45	16.21	16.22	15.95
group ave. silk yield(%)	16.27	16.51			16.19			16.13		

case. When we see the distribution chart, we can notice the BH<4 distribution shows better uniformity than the others. Now, let us discuss about the silk reeling results obtained from the nacortized pure lines. According to Table 6, the silk yield of cocoon of BH <4 shows better result than the Control or other cases. This is the same result with P_1 production already shown in Table 4.

For the safe guard of better cocoon production, it is strongly recommended to use nacorsis method during

Table 7, BH value analysis on silk ylied of treat cocoon

$S104^P$ \ $S103^P$	1	2	3
1	16.42	16.60	**16.45**
2	16.51	**15.83**	16.22
3	**16.28**	16.21	15.95

※ control 16.27%

breeding process and pure line production.

Table 7 shows a simple analytical method of nacorsis seperation which BH=4 groups are seemed to be a limited boundary between superior seperation groups and inferior seperation groups. This means that nacorsis selection should be carried out to for only BH<4 groups during breeding process and pure line production.

Table 6 shows an unexpected phenormenon that the groups of larger BH value groups show worser cocoon assorting ratios. This means that the larger BH value groups are weaker groups and ended with poor cocoon assorting results. Now, it is cleared that nacorsis seperation has a close relation with silkworm health, so far.

IV. Summary

This will be second publication regard with silkworm selection using anesthetic followed by previous report. This treatise investigated for nacorsis recovery concerned with silkworm health through more directions than the previous paper.

After the author has found a possibility of silkworm seperation through nacorsis recovery, he has recommended to use Balance Health (BH) value system to evaluate or identify silkworm health and to produce better homogeneous silkworm eggs.

Also, the author has continued the observation for the next generation how once nacortized parents affect to their family. The obtained results are summarized as followings.

1. Basic investigation

a) Hybrid silkworm variety recovers from nacorsis earlyer than pure line because it is stronger.

b) Strong pure line variety recovers from nacorsis earlyer than weak one because it is stronger.

c) Male worm recovers from nacorsis earlyer than female worm because it is stronger.

2. Establishment of Balance Health(BH) value system.

In order to identify each seperated group by nacorsis and their family, the following Balance Health (BH) value indicating system was established.

♂ \ ♀	1	2	3
1	BH 2	BH 3	BH 4
2	BH 3	BH 4	BB 5
3	BH 4	BH 5	BH 6

1. earlyer recovered group from nacorsis
2. medium recoveved group from nacorsis
3. later recovered group from nacorsis

3. In order to select better silkworm during breeding service, the BH value indicating system is strongly recommended. That is, in case BH value is smaller than four, it would be strong group or in case BH value is larger than four, it would be weak group.
4. Once nacortized parents do not harm any nature for next generation regardless P_1 or F_1 production.
5. The seperation through nacorsis may delay retrograde phenomenon some years than other case, so, this system should be used for pure line production every year.
6. It is recommended to nacortize silkworm for five minutes on breeding purpose, but two and half minutes on pure lines reproduction at fifth instar.
7. This report has been discussed in relation to practical industry promotion aspects, but there are many subjects to be solved from academical aspect in future

V. Literature cited

(1) Byong Hee Choe (1971), studies on silkworm selection by use of anesthetic (1), Seri. J. of Korea Vol. 13(2) P123-133.