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Character Analysis of Silkworm Strains Registered as Genetic Stocks in Korea

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In order for further systematic maintenance of silkworm stocks kept in Korea we analyzed character quality of a diverse array of silkworm strains originated from several sericulture-practicing countries. The analysis of about ten qualitative characters from 67 strains (13 of Japanese strains, 15 of Chinese strains, 14 of European strains, 6 of Korean and Tropical strains, and 19 of unknown origin) revealed a significant difference in the ten different qualitative characters among silkworm strains. In the analysis of quantitative characters, Japanese and European strains were highest in hatchability, the Korean and Tropical strains were highest in pupation rate, and unknown origin and Chinese strains were highest in cocoon yield and number of egg laid. With the connection of molecular genetic analysis the current data may provide the advanced ground for further systematic maintenance of valuable genetic resources of silkworms, although more breeds should be investigated for further complete pictures.

Key words: Silkworm strain, *Bombyx mori*, Qualitative characters, Quantitative character

Introduction

Genetic resources are current and future ground for evolution of new properties and, thus, they should be well organized and kept with systematic manner, because they may eventually provide ground for the production of new properties kept in the genetic resources. Once lost, it would not possible to recover permanently. Fortunately, more than 3000 silkworm (*Bombyx mori*) strains are still maintained in Europe and Asia and these carry genetic differences (Nagaraju 2000). In the Republic of Korea, more than 300 silkworm strains remain under conservation in a government institute. These strains are annually reared, and scores from indoor rearing are analyzed for consistent character maintenance. Thus, individuals with unstable heritable characters are discarded for better conservation of pure lines. Nevertheless, still much confusion on the genetic stock exists.

World-widely many methodologies to better classify silkworm strains have been devised. These include classification of silkworm varieties based on cocoon characters (Enokijima *et al.*, 1985; Yoshitake, 1968), dialleled crosses (Gamo *et al.*, 1985a, 1985b), principal component analysis and cluster analysis (Jung *et al.*, 1989), alkaline-phosphatase (Yoshitake, 1964), esterase activities (Yoshitake 1963; Yoshitake and Akiyama, 1965; Yoshitake and Eguchi, 1965; Yoshitake *et al.*, 1966; Zhi *et al.*, 1984), the number of degenerative crochets (Shimizu *et al.*, 1964), isozymes (Seong *et al.*, 1997; Sohn *et al.*, 2002), RAPD (random amplified polymorphic DNA; Hwang *et al.*, 1995), RFLP (restriction fragment length polymorphism, Shi *et al.*, 1995), and direct sequencing of mitochondrial DNA (Kim *et al.*, 2000; Hwang *et al.*, 1996, 1998).

Such abundance reversely may indicate the difficulty and complexity to discriminate one strain from the others. Furthermore, recent advance in molecular techniques again requires reexamination of once well established strains, because new insight into previous strains often results in obscurity.

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We recently started analysis of the silkworm genetic stocks kept in Korea in order to reevaluate them and to connect the information with further advanced molecular information (Kim *et al*., 2007; Kim *et al*., 2008). Therefore, in this study, we investigated each qualitative and quantitative characteristic of diagnostic 67 varieties among about 300 strains kept in Korea. We hope the information is applicable as fundamental data for the establishment of standard model for the character maintenance and strategy for the silkworm genetic resources.

Materials and Methods

Silkworm strains

Silkworm strains chosen for the present study represent a diverse source of genetic stocks: different geographic origin (Japanese race 13, Chinese race 15, Europe race 14, Korean & Tropical race 6, Unknown origin 19) (Table 1).

Breeding methods

The twenty varieties were published at every spring for 3 years from 2005 and the silkworm of 1 moth amount per variety was bred. The hatchability of eggs was carried out at temperature 15~26°C, humidity 75~80%, light condition 16 hrs and dark condition 8 hrs. By standard breeding management of sericulture test. Young silkworm (1^{st}~3^{rd} instar) rearing with paraffin paper was bred at temperature 25~26°C and humidity 75~85%. Also, grown silkworm (4^{th}~5^{th} instar) rearing with rearing tray was bred at temperature 23~24°C and humidity 65~75%. The each instar' feeding with new leaves was done 3 times per day. The test implement was arrangemented with 150 head per each straims from 2^{nd} day of 4^{th} instar.

Management after mounting of silkworm

After mounting, the environmental conditions which are most important, that is, temperature and humidity were respectively kept with 22~24 and 60~70% in order to protect for 7 days.

Protection of pupae and moths

Pupar and moth were protected with temperature 23~24°C and humidity 60~70%. The pupae were respectively separated with female and male by sexual-gland differentiation. The moth was kept with the condition of natural light in feeding room laid eggs on egg-card.

Investigation method

The color of hibernating egg was recorded before incubation. Investigation times per items are as follows. Laval marking, ant larva color, larva color, larva foot color and

Table 1. Silkworm stains utilized in the study

No.	Japanese race	No.	Chinese race	No.	European race	No.	Native & tropical race	No.	Unknown origin race
24	N74	83	Kwasulpyung	59	Ku27	145	Hansammyun	181	Je 1bakran
33	Bibakjam	85	Galwon	60	Lemone	146	Sammyunjam	184	YW
34	BakanEB kwainggi	111	Tuk C60	62	Bagdad	148	Sun 3ho	191	Damhukjam
40	Usungrokeui	119	C Hibakran	65	Shansurian	157	HM	204	cre
41	Usungjukei	122	Sammyunhong	69	Youlkukjam	296	Sandong sammyun	213	od Eujam
45	Y54yu	125	Urokbakran	70	IJPE	326	Kore sammyun	214	O9C
55	N Hibakran	128	Yonggakjam	73	LT			235	Heukho
57	Heukjam	140	Crimson	79	Huka			238	Ascori A
166	Hinode	141	Q Hibakran	80	Hojam			253	Turkish
168	Qoichuk	142	Hansung hukran	81	Hansunghojam			270	rcp
174	Il 111	143	Hansung banmun	158	Kyunsakjuk			271	J037
182	Jangsajang	162	Hoknuwe	177	Rok 191			272	Combodge
247	DY	163	Y4	179	AP			290	Eppanol
		167	Hansang 2ho	180	Z3			293	AT
		246	Hongbak					303	Jenam
								315	Bm.W
								319	NdH
								320	Nd
								342	P50

Table 2. The qualitative characteristics of Japanese race

Strains	Voltinism	Moltinism	Laval Marking	Cocoon Shape	Cocoon Color	Egg Color	Ant Larva Color	Larva Color	Larva Foot Color	Blood Color
N74	2	4	Mark	Spindle	yellowish green	greenish gray	brownish gray	greenish gray	white	Cream yellow
Bibakjam	2	4	Mark	Peanut	white	gray	blackish brown	dark gray	white	Cream yellow
BakanEB kwainggi	2	4	Plain	Long Oval	white	gray	black	pale blue	white	Cream yellow
Usun-grokeui	2	4	Mark	Long Peanut	white	gray	brownish gray	pale blue	white	Cream yellow
Usungjukei	2	4	Mark	Long Peanut	white	reddish gray	black	pale blue	white	Cream yellow
Y54yu	2	4	Mark	Long Peanut	white	grayish blue	blackish brown	pale blue	white	yellow
N Hibakran	2	4	Plain	Oval	white	cream yel-low	Brown	pale blue	white	Cream yellow
Heukjam	2	4	Striped	Oval	white	battleship gray	blackish brown	Black	white	yellow
Hinode	2	4	Mark	Oval	white	gray	Brown	Black	white	white
Qoichuk	2	4	Mark	Oval	yellow	brownish gray	blackish brown	pale blue	white	Cream yellow
Il 111	2	4	Plain	Oval	yellow	greenish gray	Brown	pale blue	white	yellow
Jangsajang	2	4	Mark	Long peanut	white	grayish blue	reddish brown	pale blue	white	Cream yellow
DY	2	4	Mark	Oval	white	grayish blue	blackish brown	pale blue	white	Cream yellow

Table 3. The quantitative characteristic of Japanese race

Strains	Hatchabilit (%)	Larva Period (date)		Pupation Rate (%)	Cocoon Yield (kg)	Cocoon Weight (g)	Pupal Weight (g)	Cocoon Shell Weight (cg)	Percentage of Cocoon Shell Weight (%)	Number of Egg Laid (eggs)
		fifth larva	whole larva							
N74	84	6.00	21.22	85.0	8.5	1.44	1.27	17.2	11.9	202
Bibakjam	68	6.06	23.04	85.9	11.1	1.44	1.26	18.4	12.8	315
BakanEB kwainggi	83	6.12	24.10	85.0	11.2	1.36	1.14	21.6	15.8	343
Usun-grokeui	88	7.06	25.04	86.5	17.0	2.09	1.71	38.2	18.3	278
Usungjukei	73	5.12	22.10	88.0	12.2	1.52	1.32	20.2	13.3	341
Y54yu	74	5.00	21.22	64.1	7.5	1.38	1.18	19.6	14.2	335
N Hibakran	90	7.06	25.10	80.5	12.5	1.67	1.32	35.0	20.9	332
Heukjam	81	6.12	24.10	69.0	8.1	1.45	1.32	12.6	8.7	260
Hinode	79	6.00	25.10	68.9	9.3	1.66	1.46	19.8	11.9	226
Qoichuk	85	6.00	23.22	83.7	12.6	1.58	1.34	23.8	15.0	362
Il 111	87	6.18	24.22	89.5	14.2	1.64	1.38	25.8	15.8	467
Jangsajang	82	6.00	23.04	94.0	14.1	1.54	1.33	21.2	13.8	391
DY	92	7.00	24.22	85.5	14.4	2.00	1.59	40.6	20.3	352
Mean	82	6.07	23.22	82.0	11.8	1.60	1.36	24.2	14.8	323

Table 4. The qualitative characteristics of Chinese race

Strains	Voltinism	Moltinism	Laval Marking	Cocoon Shape	Cocoon Color	Egg Color	Ant Larva Color	Larva Color	Larva Foot Color	Blood Color
Kwasulpyung	2	4	Mark	Oval	white	gray	blackish brown	pale blue, black	white	cream yellow
Galwon	2	4	Mark	Peanut	white	grayish blue	Brown	White, Blown	white	cream yellow
Tuk C60	2	4	Mark	Oval	white	grayish blue	Brown	grayish yellow	white	white
C Hibakran	2	4	Plain	Oval	white	soft yellow	brownish gray	pale blue	white	cream yellow
Sammyunhong	2	4	Mark	Spindle	white	dark gray	blackish brown	pale blue	yellow	yellow
Urokbakran	2	4	Mark	Peanut	white	grayish blue	reddish brown	brownish gray	white	cream yellow
Yonggakjam	2	4	Plain	Peanut	white	grayish blue	brownish gray	pale blue	white	white
Crimson	2	4	Mark	Oval	white	battleship gray	blackish brown	pale blue	white	cream yellow
Q Hibakran	2	4	Plain	Oval	white	cream yellow	blackish brown	pale blue	white	cream yellow
Hansung hukran	2	4	Plain	Oval	white	yellowish gray	blackish brown	pale blue	white	cream yellow
Hansung banmun	2	4	Mark, Plain	Peanut	white	reddish gray	reddish brown	pale blue	white	cream yellow
Hoknuwe	2	4	Plain	Peanut	white	grayish blue	reddish brown	pale blue	white	cream yellow
Y4	2	4	Mark	Peanut	soft yellow	slate gray	Brown	yellowish gray	yellow	yellow
Hansang 2ho	2	4	Plain	Oval	white	battleship gray	blackish brown	pale blue	white	cream yellow
Hongbak	2	4	Mark.	Short Oval	white	greenish gray	blackish brown	pale blue	white	cream yellow

blood color were confirmed for the period of larva development. Cocoon shape and cocoon color were identified after cocoon harvesting. The number of laying eggs was counted with the average of 5 moth amount when eggs diapaused. To investigate cocoon characters, pupation rate and cocoon yield were done after harvesting on the mounting 8th day. The means of cocoon and cocoon shell weight was respectively calculated for female and male.

Results and Discussion

Characteristics of Japanese race

Qualitative characteristics of the thirteen Japanese varieties showed 2 voltinism and 4 moltinism. In quantitative characteristics, cocoon shape showed various form such as spindle, peanut, long oval, long peanut and oval, and cocoon color was white and yellow (Table 2). In quantitative characteristics, japanese varieties showed 82%-hatchability, 82.0%-pupation rate, 11.8 kg -cocoon yield and 323 eggs-number of egg laid (Table 3).

Characteristics of Chinese race

Qualitative characteristics of the fifteen chinese varieties showed 2 voltinism, 4 moltinism. In quantitative characteristics, larva pattern showed mark, plain or mark-plain. Most of cocoon shape was oval, and larva color was most pastel blue (Table 4). In quantitative characteristics, Chinese varieties showed 79%-hatchability, 82.7%-pupation rate, 12.8 kg-cocoon yield and 377 eggs-number of egg laid (Table 5).

Characteristics of European race

In quantitative characteristics of the fourteen European varieties, they showed 1 voltinism and 4 moltinism. Larva

Table 5. The quantitative characteristic of chinese race

Strains	Hatchabilit (%)	Larva Period(date)		Pupation Rate (%)	Cocoon Yield (kg)	Cocoon Weight (g)	Pupal Weight (g)	Cocoon Shell Weight (cg)	Percentage of Cocoon Shell Weight (%)	Number of Egg Laid (eggs)
		fifth larva	whole larva							
Kwasulpyung	78	6.12	24.10	78.6	11.6	1.76	1.47	29.4	16.7	488
Galwon	85	5.12	22.10	89.5	14.0	1.56	1.34	22.2	14.2	256
Tuk C60	75	7.00	23.22	78.5	13.4	1.92	1.56	36.2	18.8	446
C Hibakran	78	7.00	25.04	93.0	14.9	1.76	1.38	38.4	21.8	418
Sammyun-hong	72	5.18	21.22	92.4	5.4	1.06	0.93	13.0	12.2	286
Urokbakran	83	6.18	23.22	53.5	8.0	1.51	1.24	27.4	18.1	339
Yonggakjam	62	6.06	25.04	67.5	9.2	1.66	1.44	22.4	13.5	333
Crimson	85	5.12	22.10	91.5	13.4	1.64	1.39	25.2	15.3	394
Q Hibakran	93	7.18	25.22	83.5	14.1	1.77	1.42	35.0	19.7	437
Hansung hukran	69	7.06	25.04	92.0	14.3	1.64	1.29	34.6	21.1	406
Hansung banmun	80	8.00	26.22	74.0	12.6	1.95	1.59	35.6	18.2	404
Hoknuwe	81	5.12	23.10	93.5	16.2	1.80	1.55	25.0	13.9	422
Y4	84	6.06	24.04	80.5	15.7	2.17	1.83	34.2	15.8	421
Hansang 2ho	84	7.00	24.04	90.5	16.9	1.9	1.50	39.6	20.9	311
Hongbak	69	7.06	25.04	82.5	12.3	1.57	1.26	31.2	19.8	298
Mean	79	6.15	24.07	82.7	12.8	1.71	1.41	30.0	17.3	377

Table 6. The qualitative characteristic of European race

Strains	Volt-inism	Molt-inism	Laval Marking	Cocoon Shape	Cocoon Color	Egg Color	Ant Larva Color	Larva Color	Larva Foot Color	Blood Color
Ku27	1	4	Mark	Peanut	deep yellowish orange	grayish blue	brown	pale blue	yellow	yellow
Lemone	1	4	Mark	Peanut	white	gray	brown	light yellow	white	cream yellow
Bagdad	1	4	Mark	Peanut	light yellow green	gray	blackish brown	light grayish pink	white	cream yellow
Shansurian	1	4	Mark	Long Oval	soft yellow	battleship gray	blackish brown	soft yellowish brown	yellow	yellow
Youlkukjam	1	4	Mark	Spindle	pale yellow	greenish gray	brown	light grayish pink	yellow	yellow
IJPE	1	4	Mark	Peanut	deep yellow	grayish blue	brown	light grayish pink	yellow	yellow
LT	1	4	Mark	Peanut	yellow	grayish blue	brown	pale blue	yellow	yellow
Huka	1	4	Striped	Peanut	deep yellow	reddish gray	blackish brown	Black	white	yellow
Hojam	1	4	Zebra	Oval	white	grayish blue	brown	Black	white	white
Hansunghojam	1	4	Mark, Plain	Peanut	white	slate gray	dark brown	Black	white	cream yellow
Kyunsakjuk	1	4	Mark	Oval	pale pink	gray	reddish brown	yellowish gray	white	cream yellow
Rok 191	1	4	Mark	Spindle	light yellow green	battleship gray	brown	pale blue	white	cream yellow
AP	1	4	Plain	Peanut	deep yellow	dark gray	reddish brown	whitish yellow	white	yellow
Z3	1	4	Plain	Oval	cream yellow	gray	brown	pale blue	yellow	cream yellow

Table 7. The quantitative characteristic of European race

Strains	Hatchabilit (%)	Larva Period (date)		Pupation Rate (%)	Cocoon Yield (kg)	Cocoon Weight (g)	Pupal Weight (g)	Cocoon Shell Weight (cg)	Percentage of Cocoon Shell Weight (%)	Number of Egg Laid (eggs)
		fifth larva	whole larva							
Ku27	83	6.00	23.04	71.4	12.4	1.78	1.55	22.8	12.8	264
Lemone	90	5.00	21.04	81.0	12.0	1.53	1.35	18.4	12.1	363
Bagdad	72	6.12	23.1	89.0	15.0	1.81	1.51	30.0	16.6	321
Shansurian	74	5.12	23.1	93.5	10.5	1.22	1.04	18.0	14.7	327
Youlkukjam	84	5.06	22.04	88.6	10.5	1.32	1.2	11.6	8.8	230
IJPE	87	7.06	25.04	90.5	13.2	1.54	1.26	28.4	18.4	279
LT	90	5.12	22.1	98.0	13.4	1.43	1.22	20.8	14.5	340
Huka	76	6.06	23.04	79.5	12.6	1.59	1.41	18.0	11.3	355
Hojam	80	6.06	23.04	81.1	11.2	1.56	1.3	25.8	16.5	313
Hansunghojam	73	6.06	23.04	88.5	13.0	1.59	1.33	26.4	16.6	398
Kyunsakjuk	81	6.00	24	89.0	9.7	1.23	1.08	15.0	12.2	295
Rok 191	76	7.06	25.04	92.0	14.2	1.51	1.31	20.4	13.5	340
AP	86	6.06	24.04	80.5	10.9	1.58	1.33	25.4	16.0	289
Z3	90	6.18	25.04	74.5	10.9	1.79	1.44	34.6	19.4	345
Mean	82	6.03	23.12	85.5	12.1	1.53	1.31	22.5	14.5	319

Table 8. The qualitative characteristic of native or tropical breed

Strains	Voltinism	Moltinism	Laval Marking	Cocoon Shape	Cocoon Color	Egg Color	Ant Larva Color	Larva Color	Larva Foot Color	Blood Color
HM	Multi	4	Plain	Spindle	white	greenish gray	dull reddish brown	pale blue	white	Cream
Hansammyun	2	3	Mark	Peanut	light yellow-ish green	battleship gray	blackish brown	blackish brown	white	Cream
Sammyunjam	2	3	Plain	Oval	white	greenish gray	blackish brown	yellowish gray	white	Cream
Sun 3ho	2	3	Plain	Plain	deep yellow	grayish blue	dull reddish brown	yellowish gray	white	Cream
Sandong sammyun	-	3	Mark	Spindle	soft yellowish orange	gray	dull reddish brown	pale blue	yellow	yellow
Kore sammyun	-	3	Mark	Oval	white	dark gray	black	black	white	white

Table 9. The quantitative characteristic of Native or tropical race

Strains	Hatchabilit (%)	Larva Period (date)		Pupation Rate (%)	Cocoon Yield (kg)	Cocoon Weight (g)	Pupal Weight (g)	Cocoon Shell Weight (cg)	Percentage of Cocoon Shell Weight (%)	Number of Egg Laid (eggs)
		fifth larva	whole larva							
HM	81	6.06	25.04	86.5	12.1	1.48	1.23	24.6	16.6	232
Hansammyun	95	6	22.22	93.5	10.6	1.19	1.05	13.6	11.5	191
Sammyunjam	79	6.06	22.1	88.5	9.8	1.28	1.11	16.8	13.1	297
Sun 3ho	75	4.12	22.1	83	8.3	0.86	1.78	7.6	8	214
Sandong sammyun	71	5	22.22	88.7	8.1	1.02	0.91	10.6	10.4	365
Kore sammyun	84	6.06	25.04	87.9	9.9	0.96	0.86	10	10.4	328
Mean	81	5.17	23.12	88	9.8	1.13	1.16	13.9	11.7	271

Table 10. The qualitative characteristic of unknown origin race

Strains	Voltinism	Moltinism	Laval Marking	Cocoon Shape	Cocoon Color	Egg Color	Ant Larva Color	Larva Color	Larva Foot Color	Blood Color
Je 1bakran	-	4	Mark	Peanut	light yellow green	greenish gray	brown	pale blue	white	cream yellow
YW	-	4	Plain	Oval	deep yellow	soft yellow	brownish gray	pale blue	yellow	yellow
Damhuk-jam	-	4	Mark	Peanut	white	pale yellowish pink	light brown	pale blue	white	cream yellow
cre	-	4	Mark	Peanut	white	pale red purple	brownish black	pale blue	white	cream yellow
od Eujam	-	4	Plain	Peanut	white	grayish blue	brownish black	pale blue	white	cream yellow
O9C	-	4	Plain	Oval	white	soft yellow	brownish black	pale blue	white	cream yellow
Heukho	-	4	Striped	Oval	deep yellow	grayish blue	brownish black	black	white	yellow
Ascori A	-	4	Mark	Oval	naples yellow	gray	brown	pale blue	white	yellow
Turkish	-	4	Mark	Oval	white	battleship gray	brown	pale blue	white	white
rcp	-	4	Zebra	Oval	white	cream yellow	brownish black	pale blue	white	cream yellow
J037	-	4	Mark	Oval	white	battleship gray	brown	pale blue	white	cream yellow
Combodge	-	4	Plain	Peanut	deep yellow	soft yellowish orange	reddish brown	pale blue	yellow, white	cream yellow
Eppanol	-	4	Plain	Spindle	deep yellow	greenish gray	brown	pale blue	greenish white	cream yellow
AT	-	4	Mark	Oval	white	battleship gray	brownish black	pale blue	greenish white	cream yellow
Jenam	-	3	Mark	Peanut	naples yellow	gray	brownish black	pale blue	pale yellow	yellow
Bm.W	-	4	Mark. Plain	Oval	cream yellow, white	reddish gray	light brown	pale blue	yellow	yellow
Nd^{H}	-	4	Mark	-	white	gray	brownish black	pale blue	white	cream yellow
Nd	-	4	Mark	-	white	dark gray	brownish black	pale blue	white	white
P50	-	4	Mark	Spindle	light yellow-ish green	battleship gray	brownish black	pale blue	white	white

pattern with mark, cocoon shape with peanut and ant larva color with brown was most (Table 6). In quantitative characteristics, European varieties showed 82%-hatchability, 85.5%-pupation rate, 12.1 kg-cocoon yield and 319 eggs-number of egg laid (Table 7).

Characteristics of the native and tropical race

In quantitative characteristics of the six native and tropical varieties, native varieties showed bivoltine and 3 moltinism. On the other hand, tropical variety (HM) showed polyvoltine and 4 moltinism. In native varieties, larva pattern was most oval, and cocoon color, egg color and larva color showed various features. In tropical varieties, larva pattern, cocoon color and ant larva color was spindle, white and red brown, repectively (Table 8). In quantitative characteristics, the native and tropical varieties showed 81%-hatchability, 88%-pupation rate, 9.8 kg-cocoon yield and 319 eggs-number of egg laid (Table 9).

The unknown origin race

In quantitative characteristics of the nineteen unknown

Table 11. The quantitative characteristic of unknown origin race

Strains	Hatchabilit (%)	Larva Period (date)		Pupation Rate (%)	Cocoon Yield (kg)	Cocoon Weight (g)	Pupal Weight (g)	Cocoon Shell Weight (cg)	Percentage of Cocoon Shell Weight (%)	Number of Egg Laid (eggs)
		fifth larva	whole larva							
Je 1bakran	95	6.00	24.04	97.5	13.7	1.49	1.25	24.4	16.4	308
YW	87	6.12	23.10	93.0	15.4	1.78	1.48	29.6	16.6	402
Damhukjam	85	5.12	23.10	79.5	12.1	1.59	1.41	18.2	11.4	440
cre	80	5.06	23.10	84.5	12.1	1.64	1.39	25.4	15.5	310
od Eujam	72	6.06	24.04	93.0	13.5	1.56	1.32	24.0	15.4	245
O9C	83	7.00	25.04	81.0	15.0	1.99	1.56	43.4	21.8	365
Heukho	83	6.00	22.22	83.0	11.8	1.51	1.27	23.6	15.6	266
Ascori A	59	6.06	24.10	37.0	4.8	1.89	1.69	20.2	10.7	203
Turkish	87	7.12	24.10	93.0	18.8	2.14	1.68	46.0	21.5	508
rcp	79	5.12	23.10	68.5	7.1	1.48	1.27	21.4	14.5	258
J037	70	8.06	25.10	85.4	16.3	2.17	1.64	53.0	24.4	527
Combodge	56	5.06	22.10	81.5	11.4	1.53	1.33	19.8	12.9	225
Eppanol	61	6.00	22.22	86.0	14.5	1.9	1.72	18.2	9.6	269
AT	94	8.00	25.22	89.3	16.2	2.17	1.65	51.6	23.7	343
Jenam	75	6.00	22.04	83.1	7.5	0.97	0.87	10.0	10.4	359
Bm.W	80	5.06	22.10	92.0	15.5	1.77	1.57	20.2	11.4	514
Nd^{H}	93	6.00	23.04	82.8	12.6	2.17	1.50	28.6	15.3	465
Nd	84	7.00	26.04	88.8	16.1	3.02	2.27	75.0	24.9	343
P50	77	6.00	22.10	88.0	9.9	1.17	1.04	13.2	11.3	478
Mean	78	6.06	23.19	83.5	12.9	1.79	1.47	29.8	16	359

origin varieties, they showed 4 moltinism and larva color with pastel blue (Table 10). In quantitative characteristics, the unknown origin varieties showed 78% - hatchability, 83.5% - pupation rate, 12.9 kg - cocoon yield and 359 eggs - number of egg laid (Table 11).

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