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Breeding of a New Silkworm Variety, Chunsujam, with a High Silk Yielding for Spring Rearing Season

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A new silkworm variety, Chunsujam, for spring rearing season is F_1 hybrid between Japanese race Jam145 bred by 8459/8711 and Chinese race Jam146 by 8544/M8626. Jam145, Japanese parent of the Chunsujam, showed high GCA in pupation rate and Jam146, Chinese parent, showed high GCA in pupation rate and single cocoon weight. In the local adaptability test performed at 8 local areas in spring of 1999, Chunsujam was 5% higher in larval weight, 3% in single cocoon weight, and 4% in cocoon yield from 10,000 of the 3rd molted larvae, respectively, than the check variety Baegokjam.

Key words : Silkworm, Breeding, Combining ability

Introduction

High cocoon yielding due to high resistance, high silk reeling ability and productivity, better silk quality in neatness and lousiness is essential for new silkworm variety to increase silk productivity. Actually, breeding of complete variety satisfying all requirement is very difficult because many of the characters mentioned above show negative correlations each other (Harada, 1961).

The breeding activities aimed to create new variety in high unit productivity started in spring rearing season because of better nutrition of mulberry leaves and better rearing condition in terms of temperature and humidity. The new variety, Chunsujam, was nominated at February of 2000 as a new recommended variety for spring rearing season through pure line test and combining ability test in Department of Sericulture & Entomology, NIAST, and local adaptability and main productivity test in Department of Sericulture & Entomology, NIAST and seven Provincial Institute of Agricultural Science & Technology (PIAST).

The pure lines of Chunsujam were named Jam145 for Japanese race and Jam146 for Chinese race. In the present report, the main breeding details and important characteristics of Chunsujam were described.

Materials and Methods

Chunsujam is single cross F_1 hybrid between Japanese race Jam145 and Chinese race Jam146. For the target to breed healthy and heavy pure lines, Japanese race pure line Jam 145 (breeding line JS133) was crossed between stock lines of 8459 and 8711 in 1991 and Chinese race pure line Jam146 (breeding line CS132) was also crossed between stock lines of 8544 and M8626 in 1990.

Targeted characters were selected through three times rearing a year with succeeding generation by mass selection in mixed batch rearing system from filial one to filial three and by individual selection in batch rearing system from filial four (F_4) to filial seven (F_7) mainly based on cocoon quality.

Jam145 Jam146 was selected to excellent combination through combining ability test in autumn rearing season of 1996 and spring rearing season of 1997, and it was passed the test of pure line characteristics and adaptability test for artificial diets performed at Department of Sericulture and Entomology, NIAST, RDA in autumn rearing season of 1998 and spring rearing season of 1999.

It was nominated to new recommended variety for spring rearing season with the name of Chunsujam at Nomination Council of Silkworm Recommended Variety (NCSRV) after the superiority for spring variety was rec-

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ognized through the local adaptability test performed at eight sericultural organs of PIAST.

Results and Discussion

Combining ability test

Generally, top cross and diallel cross, both of them are useful for genetic analysis in the silkworm variety, but top cross is more effective than diallel cross (Sohn and Hong, 1986). Connecting with this, top cross method was adopted for the combining ability test in this report.

For the breeding of a new silkworm variety for spring rearing season, Japanese race Jam145 and Chinese race Jam146 were crossed. Jam145, Japanese parental line, was bred between breeding line 8459 and 8711 at 1991 and Jam146, Chinese parental line, was bred between breeding line 8544 and M8626 at 1990. The F1 hybrid between Jam145 and Jam146 was selected as Chunsujam (Fig. 1). The economic characteristics of Jam145, Jam146 and their parental lines were described in Table 1.

The results of four by four (4 4) top cross between Japanese and Chinese races with control variety Bunongjam (Hong *et al.*, 1992) performed in autumn, 1996 and spring, 1997 are shown in Table 2. Chunsujam recorded higher pupation rate by 1 to 3% and heavier cocoon yieldings caused by heavy single cocoon weight, whereas raw silk productivity showed the same level with control. Jam145, Japanese race parent of Chunsujam, showed high general combining ability (GCA) in pupation rate and cocoon shell percentage out of examined important commercial characters, and Chinese parent of Chunsujam Jam146 recorded high GCA in single cocoon weight.

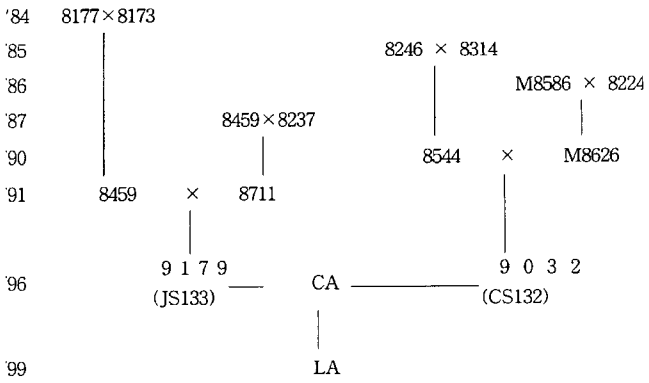

Fig. 1. The pedigree of "Chunsujam", the F_1 hybrid between Jam145 and Jam146. CA, Combining ability test; LA. Local adaptability test. JS133 and CS132 were named as Jam145 and Jam146, respectively.

Local adaptability test

Rearing Cooperative experiment of Chunsujam (Jam145 Jam146) was performed at eight places, Department of

Table 1. The economic characteristics of the Jam145, Jam146 and their parental lines

Line	Rearing season	Larval period (days)	Pupation rate (%)	Cocoon yields from 10,000 3rd molted larvae (Kg)	No. of cocoon per liter (ea)	Single cocoon weight (g)	Cocoon shell weight (mg)	Cocoon shell percentage (%)
8459	'91 spring	25.22	92.9	14.4	86	1.93	46.9	24.4
8711	'91 spring	25.03	90.6	16.6	79	1.93	49.4	23.9
Jam145	'91 summer	23.06	87.4	15.4	94	1.92	46.1	24.0
8544	'90 spring	26.03	69.9	14.3	58	2.25	57.4	25.5
M8626	'90 spring	26.08	79.7	15.6	62	2.12	50.5	23.8
Jam146	'90 summer	22.06	66.0	11.9	61	2.14	53.2	24.9

Table 2. The major commercial characteristics of Chunsujam and the general combining abilities (GCA)in spring, 1997

Variety	Pupation rate (%)	Cocoon yield from 10,000 3rd molted larvae (Kg)	Single cocoon weight (g)	Cocoon shell weight (mg)	Cocoon shell percentage (%)	Cocoon filament length (m)	Raw silk percentage (%)	Raw silk yields (Kg)
Bunongjam	93.9	22.1	2.44	59.5	24.4	1,471	21.92	4.85
Chunsujam	95.2	22.2	2.52	62.9	25.0	1,381	22.01	4.89
GCA of Jam145	2.4	0.2	-0.05	-	0.3	-	0.2	0.08
GCA of Jam146	-6.1	-0.8	0.10	-	-0.2	-	-0.4	-0.27

*The general combining abilities (GCA) of Jam145 and Jam146 were calculated out of 16 top-cross sets between 4 Japanese and 4 Chinese lines performed in autumn, 1996.

Table 3. Rearing results of Chunsujam through the local adaptability test performed at 8 places in spring, 1999

Variety	Useful hatchability (%)	Larval period (days)	Larval weight (g)	Pupation rate (%)	Best cocoon rate (%)	Double cocoon rate (%)
Baegokjam	96	24.15	5.3	95.6	94.1	0.9
Chunsujam	96	24.13	5.6	95.5	94.2	0.8

Variety	Cocoon yields per 10,000 3rd molted larvae (Kg)	No. of cocoons per liter (ea)	Single cocoon weight (g)	Cocoon shell weight (mg)	Cocoon shell percentage (%)
Baegokjam	22.7	65	2.42	59.8	24.7
Chunsujam	23.7	57	2.50	61.5	24.7

Sericulture and Entomology, NIAST and seven provincial sericultural organs concerned, to check out the productivity and local adaptability. The mean values of the test are shown in Table 3. The useful hatchability of Chunsujam was over 90 of recommending criteria for a new variety as 96% the same with Baegokjam (Lee *et al.*, 1984), and larval duration of Chunsujam was two hours shorter than that of check variety.

Pupation rate of Chunsujam was also passed the recommending criteria of 94.9% of recent three spring varieties (based on spring record of 1996) as 95.5 percent even through low record of 0.1 than check variety, and heavier cocoon crops by 1 Kg than check variety as 23.7 Kg per 10,000 of the 3rd molted larvae due to the weight and size of single cocoon.

Reeling Cocoon and raw silk characteristics of Chunsujam compared with control Baegokjam are shown in Table 4. Filament length of Chunsujam with 1,476 m was 12 m shorter than the control Baegokjam with 1,488 m, but filament weight of Chunsujam with 52.8 mg was 2.0 mg heavier than control with 50.8 mg.

Cocoon reelability with 70% and non-broken filament length with 1,044 m in the Chunsujam showed 5 higher and 26 m longer than those of check variety with 65 and 1,028 m, respectively. The neatness, degumming rate and lousiness of raw silk grade of Chunsujam were 93 points, 25.3 and 81 points, respectively.

Adaptability test for the artificial diet at young larval stages

The results of the adaptability test for the artificial diet of young silkworm of Chunsujam were illustrated in Table 5. Chunsujam was evaluated not recommendable for artificial diet with low adaptability compared with control variety Baegokjam which was widely propagated for artificial diet.

Main characteristics of parental lines

The main characteristics of Jam145 and Jam146 parental lines of Chunsujam examined with Jam123 and Jam124

Table 4. Cocoon reeling results of Chunsujam through the local adaptability test performed at 8 places in spring, 1999

Variety	Filament length (m)	Filament weight (mg)	Filament sizeb (d)	Reelability (%)	Non-broken filament length (m)	Non-broken filament weight (mg)
Baegokjam	1,488	50.8	3.11	65	1,018	28.4
Chunsujam	1,476	52.8	3.22	70	1,044	28.9

Variety	Raw silk percent (%)	Raw silk yields (Kg)	Neatness (point)	Degumming rate (%)	Lousiness (point)
Baegokjam	21.52	4.89	94	26.0	86
Chunsujam	21.55	5.11	93	25.3	81

Raw silk yields was calculated from multiplication between cocoon yields per 10,000 3rd molted larvae and raw silk percentage.

Table 5. Adaptability test for the artificial diet of silkworm in spring, 1999

Variety	Bristling rate (%)	Larval period from 1st to 3rd instar (days)	Molting rate (%)			Adaptability
			2nd	3rd	4th	
Baegokjam	96	12.08	96	95	96	Good
Chunsujam	80	12.08	70	94	93	-

Table 6. The major commercial characteristics of the parental lines of Chunsujam

Variety	Useful hatchability (%)	Larval period (days)	Pupation rate (%)	Cocoon yield per 10,000 3rd molted larvae (Kg)	Single cocoon weight (g)	Cocoon shell weight (mg)	Cocoon shell percentage (%)
Japanese races							
Jam123	97	23.18	82.6	15.8	1.95	48.3	24.7
Jam145	87	24.22	92.7	16.9	1.86	45.9	24.6
Chinese races							
Jam124	85	24.04	93.7	19.0	2.19	50.2	22.9
Jam146	96	24.04	89.0	16.9	2.20	47.8	21.8

Variety	Percentage of moth emergence (%)	Duration from incubation to moth emergence(days)	No.of eggs per batch (ea)	Percentage of moth laid normal eggs (%)	Laval marking	Cocoon shape
Japanese races						
Jam123	94	57	485	89	mark	peanut
Jam145	98	57	505	83	mark	peanut
Chinese races						
Jam124	97	55	630	100	plain	elliptical
Jam146	97	56	554	93	mark	elliptical

these of Baegokjam were illustrated in Table 6. Japanese race Jam145 showed normal marking on larvae and peanut cocoon, and pupation rate and cocoon yields by 10,000 of the 3rd molted larvae with 92.7 and 16.9 Kg were improved 11 and 7 by index than control check variety Jam123, and fecundity with 505 each per moth also increased than that of 485 each.

Chinese race Jam146 showed marking on larvae, being unusual in Chinese races, but cocoon shape showed elliptical, and pupation rate and cocoon yields by 10,000 3rd molted larvae with 89.0 and 16.9 Kg were lower than check variety Jam124 with 4.7 and 2.1 Kg, respectively, and fecundity with 554 each per moth was evaluated excellent than usual other pure lines even though it are fewer 76 each per moth than check variety with 630 each.

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