

## COMPARATIVE STUDY OF ROMANIAN AND BULGARIAN SILKWORM HYBRIDS IN ROMANIAN CLIMATE

Alexandra Matei<sup>1</sup>, G. Lenghel<sup>1</sup>, P. Tzenov<sup>2,5</sup>, Emilia Furdui<sup>3</sup>, M. Doliș<sup>4</sup>, Marilena Constantinescu<sup>1</sup>, Yolanda Vassileva<sup>5</sup>, Gabriela-Maria Cornescu<sup>1</sup>

<sup>1</sup>SERICAROM SA – Research Development Bucharest

<sup>2</sup>Black, Caspian Seas and Central Asia Silk Association

<sup>3</sup>U.S.A.M.V. Cluj- Napoca

<sup>4</sup>U.S.A.M.V. Iași

<sup>5</sup>Regional Center for Scientific-Applied Service Vratza – Bulgaria

e-mail: monicamatei47@yahoo.com

### Abstract

*In addition to the breed characteristics and the optimum needed conditions, it is necessary to ensure some efficient hybridizing systems for silkworms. The purpose of our research is to obtain information about the quality of Romanian and Bulgarian commercial hybrids and silkworm egg production intended for export. Eight simple Bombyx mori L. hybrids (four Romanian hybrids  $S_8 \times AC_{29}/T$ ,  $AC_{29}/T \times S_8$ ,  $AC \times B_1$ ,  $B_1 \times AC$  and four Bulgarian hybrids  $V_{35} \times S_2$ ,  $B_1 \times H_2$ ,  $B_1 \times S_2$ ,  $H_1 \times S_2$ ) were used as biological material. The characterization of the Bombyx mori L. hybrids was done based on nineteen biological, technological and productive characters. The hybrids are characterized by the following parameters: the larval period 685-730 hours; the weight of the raw cocoon 1,977-2,389 g; the incartment weight 0,372-0,511 g; the filament length 1010-1293 meters; the reeled silk 85,64-89,43%; the fiber fineness 2,1-2,6 d. The following hybrid combinations stand out:  $AC_{29}/T \times S_8$  and  $B_1 \times S_8$ .*

**Key words:** hybrids, Bombyx mori L., larval period, weight raw cocoon, incartment, reeled silk

### INTRODUCTION

The cross-breeding or the hybridization represents an efficient method for animal population amelioration. For silkworms, the cross-breeding is intended on one hand for the amelioration of the breeds and on the other hand for immediate economical purposes consisting in producing commercial hybrids, for which the superiority against pure breeds was demonstrated by various researchers [1], [2], [3], [7], [8], [9], [11], [13].

A series of factors influences the value of the heterosis. The results obtained by some researchers [4], [7] lead to the conclusion that using simple cross-breeding conducts to a better heterosis than in triple or quadruple heterosis. A better heterosis effect is obtained after crossing genetically different parents. It is equally notice the existence of a relation between the value of the parents' average for a certain character and the hybrid vigor manifested in F1.

References to the parents' selection effect on manifested heterosis at silkworms are mentioned in the scientific works [5], [7], [10], [12].

The concept which states that the genotype-environment interaction influences the level of heterosis it was taken into consideration on silkworms as well [6], [13], [14].

The purpose of the researches was to provide information about the quality of the commercial hybrids created in Romania and Bulgaria and to produce quality silkworm eggs for export.

### MATERIAL AND METHOD

Obtaining the studied hybrids has done using a complex system of breeding methodologies taking place in three phases, as followed:

1. The selection of the pure breeds, being well-known the fact that the efficiency of the

industrial breeding system depends on the right choice of the populations for breeding. In this phase were studied a number of 20 pure breeds, from which were selected a total number of 10 breeds, belonging equally to the Chinese group and the Japanese group, based on mixed aptitudes, respective the reproduction characters (the prolificacy, the fecundity) and the production ones (the cocoons weight, the incartment weight, the silk content, the fiber quality). The selection was done based on their own race performance, distributing their general combinative capacity.

2. The dialele cross-breeding between selected breeds obtaining a number of 20 simple hybrids followed by their study. The selection of the simple hybrids was done based on productions criteria, classified based on their breeding relevance in three groups:

- group I: pupation rate, fiber fineness, raw silk percentage;
- group II: cocoon rate, incartment rate, silk content
- group III: hatching percentage, filament length, weight filament, reeling percentage

3. The testing of the simple hybrids selected in Romania (S.C. Sericarom and U.S.A.M.V. Cluj-Napoca) and Bulgaria (Regional Center Vratza).

The experimental material was represented by eight simple hybrids, 4 Romanian ( $AC_{29}/T \times S_8$ ,  $S_8 \times AC_{29}/T$ ,  $AC \times$

$B_1$ ,  $B_1 \times AC$ ) and 4 Bulgarian ( $V_{35} \times S_2$ ,  $B \times H_2$ ,  $B_1 \times S_2$  and  $H_1 \times S_2$ ). The standard methodology for larval rearing, for obtaining the results and estimating values of the main quantitative and qualitative characters were used (Grekov and colab., 2005).

## RESULTS AND DISCUSSIONS

Using the phenotypically hybrid examination in egg and larval phases it results that the majority of tested hybrids had the egg serous colored grey and the chorion colored white.

The color of the larva's body is white-light blue, the body shape is normal, and the majority of the hybrids have larval marks. It emerged as well, that most of the hybrids have the shape of the cocoon oval-prolonged, white color, medium size and medium grana.

Table 1 and 2 present the biological and technological performances of hybrids.

The hatching percentage has values between 94,95 – 96,24 on Romanian hybrids and 93,37 – 96,28 on Bulgarian hybrids.

The pupation rate has the highest values on Romanian hybrid  $S_8 \times AC_{29}/T$  (96,42%) and the lowest on Bulgarian  $V_{35} \times S_2$  (91,36%).

High values of the raw cocoon weight have been obtained on Romanian hybrids  $AC_{29}/T \times S_8$  (2,389g) and  $S_8 \times AC_{29}/T$  (2,244g).

Table 1. Biological characters of the silkworm egg and larva

No.	Hybrids	Hatchability (%)	Larval duration (h)	5-th instar duration (h)	Pupation rate (%)
1	$S_8 \times AC_{29}/T$	95.67	695	168	96.42
2	$AC_{29}/T \times S_8$	96.19	685	168	95.87
3	$AC \times B_1$	94.95	719	192	94.46
4	$B_1 \times AC$	96.24	721	192	97.31
5	$V_{35} \times S_2$	96.28	724	192	91.36
6	$B_1 \times H_2$	93.37	696	166	93.28
7	$B_1 \times S_2$	93.88	694	170	94.36
8	$H_1 \times S_2$	95.41	730	190	95.48
9	Medium	95.25	708	180	94.82

Table 2. Technological characters of the raw cocoon

No.	Hybrids	Raw cocoon weight (g)			Shell weight (g)			Shell percentage (%)		
		♀	♂	medium	♀	♂	medium	♀	♂	medium
1	S <sub>8</sub> x AC <sub>29</sub> /T	2.413	2.076	2.244	0.496	0.474	0.485	20.5	22.8	21.6
2	AC <sub>29</sub> /T x S <sub>8</sub>	2.528	2.250	2.389	0.517	0.505	0.511	20.4	22.4	21.4
3	AC x B <sub>1</sub>	2.340	1.765	2.052	0.482	0.434	0.458	20.5	24.5	22.5
4	B <sub>1</sub> x AC	2.572	1.801	2.186	0.493	0.435	0.464	19.1	24.1	21.6
5	V <sub>35</sub> x S <sub>2</sub>	2.118	1.837	1.997	0.370	0.389	0.379	17.4	21.1	19.2
6	B <sub>1</sub> x H <sub>2</sub>	2.040	1.778	1.109	0.375	0.369	0.372	18.3	20.7	19.5
7	B <sub>1</sub> x S <sub>2</sub>	2.353	2.007	2.180	0.427	0.410	0.418	18.1	20.4	19.2
8	H <sub>1</sub> x S <sub>2</sub>	2.196	1.969	2.051	0.397	0.468	0.433	18.1	22.8	20.5
9	Medium	2.320	1.935	2.123	0.444	0.435	0.440	19.0	22.3	20.6

Data concerning the weight of the silk content place the Romanian hybrids on the first place (AC<sub>29</sub>/T x S<sub>8</sub> - 0,511g; B<sub>1</sub> x AC - 0,464g). Hybrids characterized by a high percent of silk content are: S<sub>8</sub> x AC<sub>29</sub>/T (22,8%); AC x B<sub>1</sub> (24,5%) and H<sub>1</sub> x S<sub>1</sub> (22,8%).

Table 3 and 4 present the technological characters of the dry cocoon and the silk fiber.

As seen in table 3 the average weight of the dried cocoon for the hybrid combinations tested is 0,822g, standing out the hybrid AC<sub>29</sub>/T x S<sub>8</sub>.

Among the hybrids with the best length of the fiber are AC<sub>29</sub>/T x S<sub>8</sub> (1293m); B<sub>1</sub> x AC (1266m); B<sub>1</sub> x S<sub>2</sub> (1256m) in rapport with the average of the hybrid combinations.

Table 3. Technological characters of dry cocoon and silk fiber

No.	Hybrids	Dry cocoon weight (g)	Filament length (m)	Transverse axle (mm)	Longitudinal axle (mm)	Numbers of cocoons per liter
1	S <sub>8</sub> x AC <sub>29</sub> /T	0.783	1,159	19.1	35.9	72
2	AC <sub>29</sub> /T x S <sub>8</sub>	0.965	1,293	18.6	38.1	60
3	AC x B <sub>1</sub>	0.862	1,208	20.2	37.8	61
4	B <sub>1</sub> x AC	0.881	1,266	19.6	41.0	60
5	V <sub>35</sub> x S <sub>2</sub>	0.898	1,208	11.7	29.0	60
6	B <sub>1</sub> x H <sub>2</sub>	0.690	1,010	19.9	29.2	66
7	B <sub>1</sub> x S <sub>2</sub>	0.669	1,256	17.1	37.2	72
8	H <sub>1</sub> x S <sub>2</sub>	0.828	1,178	19.8	35.7	70
9	Medium	0.822	1,184	18.2	35.4	65

Table 4. Technological characters of the silk fiber

No.	Hybrids	Row silk (%)	Reeling percentage (%)	Filament size (d)	Nr. Metric (m/g)
1	S <sub>8</sub> x AC <sub>29</sub> /T	40.74	87.15	2.4	3,633
2	AC <sub>29</sub> /T x S <sub>8</sub>	34.40	87.13	2.5	3,593
3	AC x B <sub>1</sub>	41.18	86.58	2.6	3,402
4	B <sub>1</sub> x AC	41.31	89.43	2.5	3,478
5	V <sub>35</sub> x S <sub>2</sub>	39.19	85.64	2.6	3,431
6	B <sub>1</sub> x H <sub>2</sub>	34.34	85.55	2.1	4,261
7	B <sub>1</sub> x S <sub>2</sub>	44.99	89.05	2.1	4,172
8	H <sub>1</sub> x S <sub>2</sub>	43.11	85.81	2.7	3,299
9	Medium	39.90	87.04	2.4	3,658

The reeling percentage is high on all the hybrid combinations tested but remarkable are the hybrids  $B_1 \times AC$  (89,43%) and  $B_1 \times S_2$  (89,05%).

The hybrids with the highest percentage in raw silk were:  $B_1 \times S_2$  (44,99%) and  $AC \times B_1$  (41,18%). The hybrid combinations have realized an average of the fiber fineness of 2,4 d.

Also, the metric number of the fiber is 3658 m/g.

## CONCLUSIONS

Eight simple silkworm sp. *Bombyx mori* L. hybrids (4 Romanian hybrids  $S_8 \times AC$  29/T;  $AC$  29/T  $\times$   $S_8$ ;  $AC \times B_1$ ;  $B_1 \times AC$  and 4 Bulgarian hybrids  $V35 \times S_2$ ;  $B_1 \times H_2$ ;  $B_1 \times S_2$ ;  $H_1 \times S_2$ ) were tested in two of the Romanian's regions (S.C. Sericarom – Baneasa and U.S.A.M.V. Cluj- Napoca). The hybrids were obtained using diallele cross-breeding.

The hybrids characterization was realized based on 19 biological, technological and production characters.

Romanian hybrids are characterized by: hatching percentage (94,95 - 96,24%), weight raw cocoon (2,186 - 2,389g), incartament (0,464- 0,511), fiber length (1159-1293m) and reeling silk percentage (86,58 - 89,43%).

Bulgarian hybrids are characterized by: hatching percentage (93,37 - 96,28%), weight raw cocoon (1,977 - 2,051g), incartament (0,372 - 0,433), fiber length (1010-1256m) and reeling silk percentage (85,55 - 89,05%).

As seen in the obtained results, the recommendation for the silkworm egg export are the following hybrid combinations:  $AC29/T \times S_8$  and  $S_8 \times AC29/T$  and  $V35 \times S_2$  and  $B_1 \times S_2$ .

## REFERENCES

[1] Das, S. K., Pattnaik S., Ghosh B., Singh T., Nair B. P., Sen S.K., Subba Rao, C. (1994)- Heterosis analysis in some three- way crosses of *Bombyx mori* L., *Sericologie* 34(1), pag.51-61  
 [2] Datta, R., K. (1984)- Improvement of silkworm races (*Bombyx mori* L.) in India. *Sericologia*, 24, pag 393-415  
 [3] Matei, A. (1989) – Influenta tipurilor de incrucisare asupra manifestarii heterozisului la viermii de matase. Lucrare prezentata in cursul proiectului de cercetare cu A.S.A.S.  
 [4] Matei, A., Chioveanu, G., Petkov, N. (2006) – Comparative study on some Romanian and Bulgarian silkworm hybrids with the aim of their introduction in the family sericultural seed farms. I. Economical characters of the egg and larva. I.D. S.A. The 5 th

anniversary symposium of the Institute for diagnosis and animal health, pag. 153-155

[5] Matei, A., Petkov, N., Tzenov, P., Androne, M., Petkov, Z., Vassileva, Y., (2008) – Comparative study of some Romanian and Bulgarian silkworm hybrids with the aim of their introduction in the family sericultural seed farms. II. Technological and productive traits of the raw cocoon, The 7<sup>th</sup> International Symposium of Animal Biology and Nutrition, Balotesti, Romania

[6] Matei, A., Marghitas, L., Dezmiorean, D., Pasca, I., Petkov, N., Bentea, M., Tzenov, P., Vassileva, Y. (2009) - Comparative study of some romanian and bulgarian silkworm with the aim of their introduction in the family sericultural seed farms. III. Technological and parameters of the dry cocoon and silk filament, The 8<sup>th</sup> International Symposium of Animal Biology and Nutrition, Balotesti, Romania

[7] Nagaraju, J., Raje Urs, Datta, R.K. (1996) – Crossbreeding and heterosis in the silkworm – *Bombyx mori*, a review. *Sericologia*, 36(1), pag.1-20  
 [8] Ohi, H., Miyahoara, J., Yamashita, A. (1970) – Analysis of various practically important characteristics in the silkworm in early breeding generations of hybrids. Variation among strains, correlation between parents and offspring as well as relation between each character. *Tech. Bull. Sericult. Exp. Sto. MAFF*, 93, pag. 39- 48

[9] Petkov, N., Yolov, A. (1979) – Influence of cocoon size and weight on heterosis effect in silkworm – *Bombyx mori* L., *Genet. Sel.* 12, pag. 286- 291

[10] Rajanna, K.L., Puttaraju H. P. (1998) – Heterosis among lines selected for pupal weight in the interline hybrids of the silkworm *Bombyx mori* L., *Sericologia*, 38(4), pag. 587-595

[11] Tayade, D. S. (1987) – Heterosis effect on economic traits of new hybrid of silkworm, *Bombyx mori* L., under Marathwada condition. *Sericologia*, 27, pag. 301- 307

[12] Razdan J. L., Bali, R. K., Mukherjee P. (1994) – Studies on the identification of region specific heterostic crosses in *Bombyx mori* L. *Sericologia*, 34(2), pag.249-260

[13] Singhr., Rachna Guel, Rekha. M., Premalatha, V., Ahsan M. M., Datta R. K. (2001) – Evaluation of multivoltine and bivoltine F1 hybrids of the mulberry silkworm, *Bombyx mori* L. in two different seasons. *Sericologia*, 41 (2), pag. 231-238

[14] Suresh, Kumar, N., Kishor Kumar C. M., Basavarja, H.K., Mall Reddy N., Ramesh Babu M., Datta R.K. (1999) – Comparative performance of robust and productive bivoltine hybrids of *Bombyx mori* L. under high temperature, conditions. *Sericologia*, 39 (4), pag. 567- 571

[15] Tzenov, P., Petkov N., Natcheva Y. (1994) – Studies on heterosis expression and degrees of dominance displayed for some quantitative traits characterizing the food utilization in F1 crosses between Japanese and Chinese bivoltine races of silkworm, *Bombyx mori* L. *Sericologia*, 34(3), pag.421- 429