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Comparative Study of Biological and Technological Parameters Regarding Silkworm Bred in Transylvania

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Abstract. Fifteen silkworms, *Bombyx mori L.*, seven breeds and eight hybrid combinations were subjected to a comparative study. The silkworms were breaded in specific Transylvanian conditions, being assured the same microclimate and were fed with the same mulberry leaves of *Morus alba* (Ukraina 107 variety). In this study we analyze some productive parameters in cocoons of *Bombyx mori L.*: raw and dried cocoon mass (g), longitudinal and transversal axis of raw and dried cocoon (cm), longitudinal/transversal ratio raw and dried cocoon, silk incartment (g), cocoon waste (g), filament length (m). Data obtained after measurements, indicates that hybrid B_1 X $SVILA_2$ had the best values for the biological parameters of the raw cocoon, also for the incartment. For the dried cocoon, breeds RG_{90} and AC_{29}/T were highlighted. According to the filament length, the best values were obtained for AC_{29}/T XS_8 hybrid.

Keywords: *Bombyx mori L.*, cocoon, silk, incartment, breeds; hybrids

INTRODUCTION

The silkworm (*Bombyx mori L.*) is a domesticated insect, which feds exclusively on mulberry leaves to produce raw silk in the form of cocoon. Silk manufacturing has been valuable in numerous cultures for many years (Good, 1995; Kadolph, 2007). The cocoon of most insect larvae is an intricate structure potentially serving numerous simultaneous functions; the cocoon is generally thought to provide the pupa with protection against predators, biodegradation, and dehydration (Gauthier et al., 2004; Weisman *et al.*, 2008). Cocoon fibers also have both antifungal and antibacterial properties (Danks, 2004).

A cocoon is a natural polymeric, made of a single continuous silk strand with a length in the range of 1000–1500 m and conglutinated by sericin. The raw silk contains two proteins, sericin and fibroin. The cocoon development has been investigated by Kaise, 2003; Musayev, 2005; Van der Kloot *et al.*, 1953. Cocoon color may fluctuate with naturally occurring shades of white, yellow, golden yellow, straw, pink, and green silk (Takashi *et al.*, 2007).

MATERIALS AND METHODS

Bombyx mori larvae were obtained from SC SERICAROM (Bucharest, Romania), standard methodologies for larval rearing were used and the same microclimate and nutrition condition were assured for the whole period of larval stage for all breeds and hybrids, because rearing performance affects growth and development of larvae and cocoon production (Thapa *et al.*, 2005).

Biological material used was represented by 7 breeds: S_8, IBV, RG_{90}, B_1, AB, Ac/T, AC_{29}/T; and 8 hybrids: B_1X AC; ACX B_1; AC_{29}/TXS_8; S_8XAC_{29}/T; $HESA_1$X $SVILA_2$; B_1X $SVILA_2$; B_1 X $HESA_2$; $VRATZA_{35}$ X $SVILA_2$.

To obtain certain shape and size cocoons, we followed that all plastic hedgehog assures enough space for each cocoon. Otherwise, deformed cocoons would have been obtained, due to the lack of space, or silk would have been lost, due to wider spaces. The best time to harvest the cocoons is determined by shaking it. The cocoons in the experiment were well shaped, strong, with silky incartment, with no holes and stains.

To measure the dried cocoons, they were stoved with hot air for 2 hours at 70°C, according to Pasca *et al.*, 2011.

The aim of this study is to analyze some productive parameters in *Bombyx mori L.*: raw and dried cocoon mass (g), longitudinal and transversal axis of raw and dried cocoon (cm), longitudinal/transversal ratio raw and dried cocoon, silk incartment (g), cocoon waste (g), filament length (m).

RESULTS AND DISCUSSION

The silkworms were placed at the end of the fifth larval instar in 22°C and 65% RH to spin cocoons according to Ramachandra *et al.*, 2001. A silkworm constructs a complete cocoon within 60–70 h. The raw cocoon quality was determined after harvest by classifying them in good quality, double cocoons and unspinnable cocoons. After that all cocoons were weighted, the ones underweight were removed.

Tab. 1

Biological and technological parameters of breed and hybrids silkworm bred in Transylvanian conditions

Breeds/Hybrids	n	Cocoon raw		Cocoon dried		Cocoon waste (g)
		Mass of cocoon (g)	Silk incartment (g)	Mass of cocoon (g)	Silk incartment (g)	
S 8	20	1.76±0.19	0.36±0.02	0.61±0.04	0.25±0.01	0.033±0.006
B1 x Ac		1.77 ±0.12	0.37±0.02	0.59± 0.03	0.29±0.01	0.033±0.008
Ac 29/T		1.54±0.24	0.35±0.03	0.83±0.07	0.34±0.04	0.029±0.005
Vratza35 xSvila2		1.78±0.13	0.36±0.02	0.74±0.05	0.23±0.02	0.026±0.008
B1 x Svila 2		1.94±0.20	0.41±0.03	0.69± 0.08	0.21±0.04	0.029±0.006
Ac 29/T x S8		1.78±0.13	0.35±0.01	0.63±0.04	0.26±0.01	0.035±0.01
Ac/T		1.49±0.21	0.36±0.05	0.79±0.03	0.25±0.01	0.031±0.006
IBV		1.21±0.17	0.29±0.05	0.62±0.02	0.17±0.04	0.021±0.003
S8 x Ac 29/T		1.80±0.19	0.37±0.03	0.77±0.09	0.27±0.01	0.029±0.003
B1		1.59 ±0.20	0.36±0.03	0.76±0.04	0.19±0.01	0.031±0.008
RG 90		1.51±0.27	0.27±0.04	0.87±0.05	0.22±0.03	0.028±0.007
B1 x Hesa 2		1.70±0.17	0.36±0.04	0.65±0.05	0.27±0.05	0.038±0.004
Ac x B1		1.621±0.16	0.33±0.01	0.65±0.08	0.25±0.02	0.034±0.003
Hesa 1 x Svila 2		1.68±0.23	0.35±0.03	0.68±0.08	0.19±0.01	0.037±0.004
AB		1.63±0.16	0.33±0.04	0.59±0.06	0.21±0.02	0.029±0.006
Average	300	1.65±0.17	0.34±0.03	0.69±0.08	0.24±0.04	0.31±0.004

The mass of raw cocoons, according to *Table 1*, reaches maximum values of 1.94 g for B_1 X $SVILA_2$ hybrid and minimum values of 1.21 g for IBV breed, with average mass of 1.65 g. Raw cocoons masses values between 1.622 g and 1.877 g were obtained by Das *et al.*, in 1994 and Alexandra Matei in 1993 with values between 1.622 g and 2.162 g.

The smallest value of raw cocoon mass silk incartment were recorded for RG_{90} breed with 0.27 g, the largest, 0.41 g, for B_1X $SVILA_2$ hybrid, the average mass was 0.34g. It is easy to observe that B_1X $SVILA_2$ hybrid had the best values of the raw cocoon mass and for the silk incartment. The IBV and RG_{90} breeds had the smallest values for the measurements above.

Regarding the dry cocoon mass, the highest value of 0.87 g was recorded for RG_{90} breed, the lowest, of 0.59 g, for AB breed and B_1XAC hybrid. Average mass for dry cocoons was 0.69 g for both breeds and hybrids. About silk incartment average value, the lowest was recorded at IBV breed, 0.17 g, the highest, 0.34 g, for AC_{29}/T breed.

Following the results obtained for cocoon waste mass, we can observe values between 0.021 g for IBV breed and 0.038 g for B_1 X $Hesa_2$ hybrid, the average being 0.031 g.

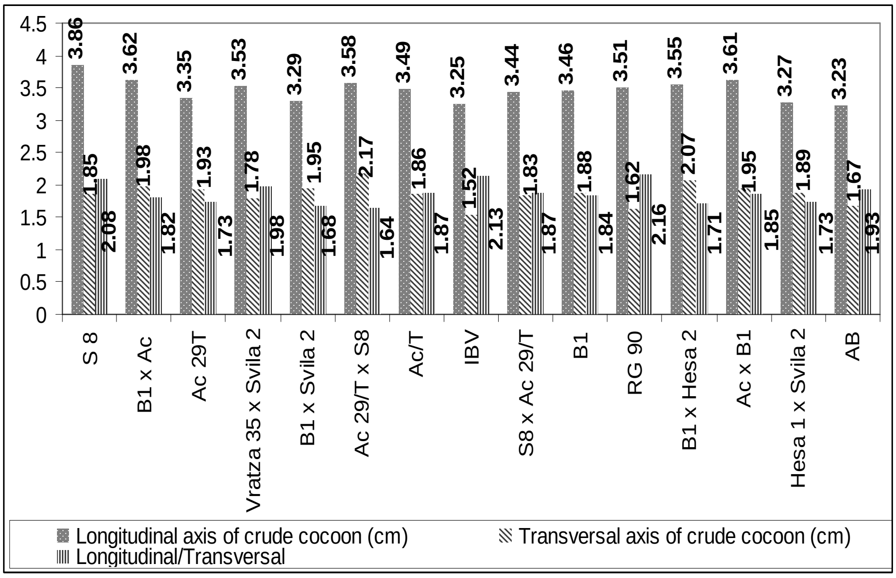

Fig. 1. Length of longitudinal and transversal axes of raw cocoons of *Bombyx mori L.* breeds and hybrids

The average value of the cocoon length (3.86 cm) was recorded at S_8 breed, the smallest value (3.23 cm) at AB breed. Regarding transversal axis, the recorded values are between 1.52 cm for IBV breed and 2.17 cm for AC_{29}/TX S_8 hybrid.

We can observe that at breeds and hybrids with lower ratio between longitudinal and transversal axes, the cocoon shape is rounded, in our case AC_{29}/TX S_8, meanwhile, for RG_{90} breed, the ratio being larger, the cocoon is more elongated.

The average value of dry cocoon longitudinal axes is between 3.78 cm for B1 x $Hesa_2$ hybrid and 2.62 cm for AC_{29}/T breed. The values for transversal axe were between 1.99 cm for B_1xAc hybrid and 1.37 cm for B_1 breed. The ratio value for longitudinal/transversal axe is between 2.53 cm for B_1x $Hesa_2$ hybrid and 1.41 cm for AC_{29}/T breed.

For the filament length, the maximum average value of 1256 m was recorded for AC_{29}/T X S_8 hybrid, the minimum one was 1008 m for B_1X $HESA_2$ hybrid.

The results recorded can be compared to the ones that Alexandra Matei *et al.*, in 2002 obtained for some hybrids, where, the average values were between 1146 m and 1286 m and for some breeds between 1123 m and 1207 m.

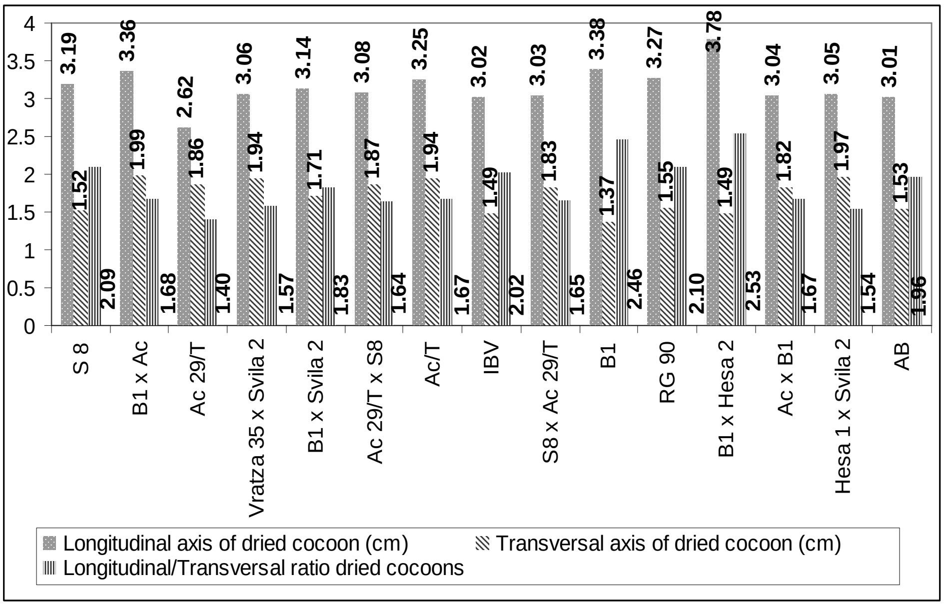

Fig. 2. Length of longitudinal and transversal axes of dried cocoons of *Bombyx mori L.* breeds and hybrids

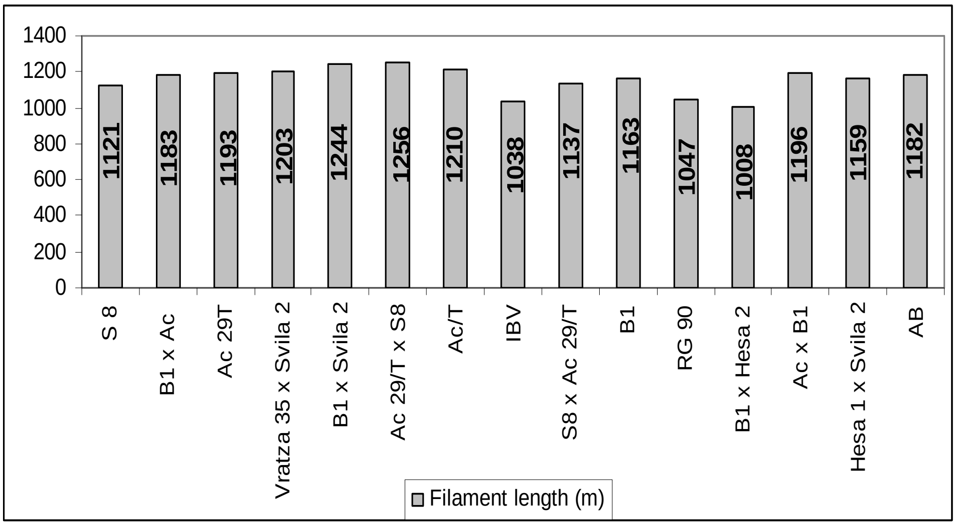

Fig. 3. Filament length of breeds and hybrids

CONCLUSIONS

The raw cocoon mass was between 1.94 g for B_1x SVILA$_2$ hybrid and 1.21 g for IBV breed, which demonstrates that hybrid have good characters and can be raised in the future. Regarding the dry cocoon mass, the highest value was 0.87g for RG$_{90}$ breed, the lowest, 0.59g, for B_1X AC hybrid.

We can observe that at breeds and hybrids with lower ratio between longitudinal and transversal axes, the cocoon shape is rounded, in our case AC$_{29}$/TX S$_8$, meanwhile, for RG$_{90}$ breed, the ratio being larger, the cocoon is more elongated.

The results indicate that hybrids are superiors to parents, due to heterosis effect.

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