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Evaluation of Genetically Sex-Marked at Eggs and Larvae Stage Silkworm *Bombyx mori* L. Hybrids Based on Silk Productivity

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Abstract

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Raw silk productivity per day of Vth larval instar and its heterosis was studied in six F1 industrial crosses, created with participation of five original sex-limited parent lines, incl. two ($T_{15/4}$ and $XT_{215/38}$) sex-marked at eggs stage and three ($TV_{3/2}$, $TBV_{2/24}$ and $B_{2/6}$) sex-marked at larvae stage.

It was determined that tested F1 hybrids created from sex-limited lines are characterized with comparatively high silk productivity per day of V^{th} instar and $XT_{215/38}$ x $TV_{3/2}$ hybrid and reciprocal cross had the highest value of this trait (3.13 - 3.19 cg).

Almost all crosses were demonstrated comparatively high heterosis manifestation concerning silk productivity over MP value within the limits of 4.81 - 12.52 % and over HP value between 3.55 - 8.63 %.

Key words: silkworm, sex limited lines, silk productivity, cocoon shell weight

Introduction

It is well known that used silkworm *Bombyx mori* L. hybrids are one of the main factors for intensification of cocoon and raw silk production (Petkov, 1995; Rajhavendra Rao et al., 2004).

According to many researchers (Petkov, 1984, 1995; Hirata, 1985; Osawa and Harada, 1994; Raghavendra Rao et al., 2004) industrial crossing between two or more initial forms (races, lines) with different geographical origin is one of the most effective methods for selection and

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using of high heterozygous silkworm F_1 hybrids. In the same moment not always high fresh cocoon productivity correspondents with high silk productivity (Rajhavendra Rao et al., 2004).

Since silk is the ultimate product of commercial purpose in textile industry many scientists has paid special attention on evaluation of silk productivity heterosis in F1 Bombyx mori L. hybrids (Udupa and Gowda, 1988; Singh et al., 1994; Bhargava et al., 1996; Ramesh Babu et al., 2001; Rajhavendra Rao et al., 2004).

The aim of the present study was to evaluate some new-selected original genetically sex-limited silkworm hybrids on the basis of silk productivity in connection to use the best of them for industrial cocoon production.

Material and Methods

Experimental and theoretical work was done at Regional Centre for Scientific Applied Service, Vratza during the period of 2004-2005.

Object of our experiment was five new selected silkworm lines, including two ($T_{15/4}$ and $XT_{215/38}$) sex-marked at eggs stage and three ($TV_{3/2}$, $TBV_{2/24}$ and $B_{2/6}$) sex-marked at larvae stage and six F_1 hybrid forms created from them.

All lines and hybrids were reared in four replication with 200 individuals, counted after second larvae moult.

Raw silk productivity per day was calculated through the formulas of Udupa and Gowda (1988):

$$\text{Cocoon shell weight (cg)} = \frac{\text{Cocoon shell weight of 25 male cocoons} + \text{25 female cocoon}}{50}$$

$$\text{ERR (\%)} = \frac{\text{number of cocoons harvested x 100,}}{\text{number of larvae after second moult}}$$

Where: ERR - Effective rate of rearing percentage.

$$\text{Silk productivity per day (cg)} = \frac{\text{ERR \% x Cocoon shell weight (cg)}}{\text{Vth instar larval duration (days)}}$$

Heterosis manifestation over Mid-parent value (MP) and over parent with the highest value (HP) were calculated as per the procedure followed by Bhargava et al. (1993):

$$\frac{F_1 - MP}{MPH} x100 \qquad \frac{F_1 - HP}{BPH} x100$$

Results and Discussion

Compared data for Effective rate of rearing percentage (ERR%), cocoon shell weight, Vth instar larval period and silk productivity per day are presented in Table 1.

It is evident that ERR percentage in pure lines and in F_1 hybrid forms as well was varied in wide limits, from 91.83 % for $T_{15/4}$ genetically sex-marked at eggs stage line to 94.06 % for $TBV_{2/24}$ genetically sex-marked at larvae stage and from 93.38 % for $XT_{215/38}$ x $B_{2/6}$ to 95.52 % for $TBV_{2/24}$ x $T_{15/4}$.

The highest ERR percentage was obtained in

$TV_{3/2}$ and $TVV_{2/24}$ initial lines (93.24 % and 94.06 %) and $XT_{215/38}$ x $TV_{3/2}$ straight and reciprocal cross (94.48 % and 95.29 %). T-15/4 and $XT_{215/38}$ x $B_{2/6}$ had the lowest value of this character, 91.83 % and (93.38 %, 94.02 %), respectively.

Table 1

Productivity of raw silk at parent's lines and their hybrids

Lines / Hybrids	ERR %	Cocoon shell weight cg	V^{th} larval instar duration days	Silk productivity per day cg
$T_{15/4}$	91.83	23.85	8.04	2.72
$XT_{215/38}$	92.09	24.21	8.17	2.73
$TV_{3/2}$	93.24	25.65	8.13	2.94
$TBV_{2/24}$	94.06	26.20	7.96	3.10
$B_{2/6}$	92.12	23.65	7.83	2.78
$T_{15/4}$ x $TBV_{2/24}$	94.10	26.75	8.25	3.05
$TBV_{2/24}$ x $T_{15/4}$	95.52	27.55	8.21	3.21
$XT_{215/38}$ x $TV_{3/2}$	94.48	27.11	8.19	3.13
$TV_{3/2}$ x $XT_{215/38}$	95.29	27.85	8.33	3.19
$XT_{215/38}$ x $B_{2/6}$	93.38	26.20	8.13	3.01
$B_{2/6}$ x $XT_{215/38}$	94.02	25.92	8.08	3.02

In respect to cocoon shell weight $TBV_{2/24}$ and $TV_{3/2}$ lines and $TBV_{2/24}$ x $TV_{3/2}$ and $T_{15/4}$ x $TBV_{2/2}4$ straight and reciprocal crosses had the highest values, 26.20 cg, 25.65 cg, (27.11 - 27.85 cg) and (26.75 - 27.55 cg), respectively.

One of the main and at the same time the most complicated for prognostication Bombyx mori L. trait is silk productivity per day. It is closely connected and in functional dependence on other silkworm biological and cocoon technological characters (silkworm pupation ratio, Vth larval instar duration, cocoon shell weight, etc.). Therefore silk productivity per each day of Vth instar is an integral quantitative character for combining and integrating of other characters, which are set up its nature. In this aspect $TV_{3/2}$, $TBV_{2/24}$ lines and $XT_{215/38}$ x $TV_{3/2}$ hybrid (straight

Table 2

Manifestation of heterosis concerning silk productivity character

Hybrids	F_1 value	Mid-parent value	High-parent value	Heterosis in % over	
				MP	HP
$T_{15/4}$ x $TBV_{2/24}$	3.05	2.91	3.1	4.81	-1.61
$TBV_{2/24}$ x $T_{15/4}$	3.21	2.91	3.1	10.31	3.55
$XT_{215/38}$ x $TV_{3/2}$	3.13	2.835	2.94	10.41	6.46
$TV_{3/2}$ x $XT_{215/38}$	3.19	2.835	2.94	12.52	8.5
$XT_{215/38}$ x $B_{2/6}$	3.01	2.755	2.78	9.25	8.27
$B_{2/6}$ x $XT_{215/38}$	3.02	2.755	2.78	9.62	8.63

and reciprocal cross) were distinguished with the highest silk productivity per day, 2.94 cg, 3.10 cg, 3.13 cg and 3.19 cg, respectively.

From the data in Table 2 is evident that all tested hybrids, except for $T_{15/4}$ x $TBV_{2/24}$ manifests heterosis in F_1 concerning silk productivity per day. Heterosis toward Mid-parent value was varied from 4.81 to 12.52 %, and over High-parent value from 3.55 to 8.63 %, respectively.

According to us heterosis manifestation of silk productivity in tested F_1 hybrids, created from genetically sex-marked lines was due to over dominant inheritance with contribution of the better parent (Petkov et al., 2004).

Conclusions

Tested F_1 hybrids created from genetically sex-marked at eggs and larvae stage lines were characterized with comparatively high silk productivity.

$XT_{215/38}$ x $TV_{3/2}$ hybrid (straight and reciprocal cross) had the highest productivity per day (3.13 - 3.19 cg).

The majority of tested crosses were distinguished with comparatively high heterosis in F_1 toward Mid-parent value (4.81 % to 12.52 %) and 3.55 % to 8.63 %, respectively toward High-parent value.

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