Study on New F1 Silkworm Hybrids with regards to the Values of Some Quantitative characters Influencing Silk Production

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Abstract

The present research paper aims at studying the newly created silkworm hybrids regarding some important quantitative characters, which have influence on silk production. The study was conducted in the Agricultural University of Plovdiv in the period 2020–2021. The following newly created F1 hybrids were examined: Vratsa 63xLine22 x Nig2xMerefa6 and Nig2xMerefa6 x Vratsa 63xLine22. The industrial hybrid Super 1 x Hesa 2 was used as a control. The received results showed that the new hybrids domineered over the regional hybrid Super 1 x Hesa 2 with relation to the values of the following features: eggs hatchability, pupation rate, as well as shorter larval period duration and the fifth instar duration. These four quantitative characters are of a great importance for receiving high yields of cocoons with a lower own-value.

Key words: hybrids, *Bombyx mori L.*, quantitative characters

Проучване на новосъздадени F1 хибриди копринена буба по отношение стойностите на някои количествени признаци, оказващи влияние върху производството на коприна

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Резюме

Целта на настоящото проучване е да се изследват новосъздадени хибриди на черничевата копринена пеперуда по отношение на някои важни количествени признаци, които оказват влияние върху производството на коприна. Проучването е проведено в Аграрен университет – Пловдив в периода 2020–2021 г. Изпитани са новите F1 хибриди Враца 63хЛиния22 х Nig2x-Мерефа6 и Nig2xМерефа6 х Враца 63хЛиния22, а за контрола е използван промишленият хибрид Супер1 х Хеса2. Получените резултати показват, че новосъздадените хибриди превъзхождат районирания хибрид Супер 1 х Хеса 2 по отношение стойностите на признаците люпимост на бубеното семе и жизненост на бубите, имат също така и по-кратка продължителност на ларвения стадии и на пета възраст от развитието на бубите. Тези 4 количествени признака са от голямо значение за получаването на високи добиви пашкули с по-ниска себестойност.

Ключови думи: хибриди*, Bombyx mori L.,* количествени признаци

Introduction

The increase and stabilization of yields demand the creation and introduction into practice of highly productive silkworm breeds, lines and hybrids possessing high adaptability at different conditions (Petkov, 1984).

According to Petkov (1984, 1995), the high effectiveness of the selective programs for *Bombyx mori L.* should be due the genitive grounds that build up the modern systems for selection and breeding of breeds, lines and hybrids.

According to numerous research studies (Petkov, 1984, 1995; Natcheva and Petkov, 1996; Petkov et al., 1999, 2001, 2003, 2004, 2005), the effectiveness of the selection systems, as well as the temp of the genetic progress of silkworm are defined to a great extent by the genetic diversity of the main productive features in the common phenotype diversity.

Silkworm selection has led to a significant increase in cocoon production worldwide, as well as to an increase of cocoon yield and quality (Seidavi and Bizhannia, 2008 a; Neshagaran Hemmatabadi et al., 2011 b).

One of the goals of silkworm breeding and selection is to improve their characteristics, as well as to increase sericulture profitability (Groen, 1990; Sing et al., 1998; Ghanipoor et al., 2006; Talebi & Subramanya, 2009; Mubasher et al., 2010; Salehinezhad, 2010 a; Seidavi, 2010 a, 2010 b, 2010 c).

According to Bizhannia and Seidavi (2008), the factors influencing cocoon and raw silk production are the genetic potential of the used breeds, the quality of silkworm eggs, disease and pest control, the quality of the used mulberry leaf, the breeding period and the technology used for cocoon enlacing.

The present research paper aims at studying newly created silkworm hybrids with regards to some important quantitative characters having influence on silk production.

Materials and methods

The study was conducted in the Agricultural University of Plovdiv in the period 2020–2021. The following F1 hybrids were examined: Vratsa 63xLine22 x Nig2xMerefa6 and Nig2xMerefa6 x Vratsa 63xLine22; the industrial hybrid Super 1 x Hesa 2 was used as a control.

Each hybrid was tested at optimum breeding conditions in two repetitions by 300 silkworms counted after the second sleep. The breeding conditions are presented in Table 1.

The following indicators were analyzed: eggs hatchability, larval period duration, Vth instar duration, pupation rate, the number of normal eggs (eggs) in 1 g and good quality cocoons. Data were processed statistically via a one-factor dispersion analysis (Lidanski,1988).

Table 1. Breeding conditions
Таблица 1. Условия на отглеждане на бубите

Instar Възраст	Temperature, °C Температура, °C	Humidity, % Влажност, %	Feeding space for 1 box of eggs, m^2 Хранителна площ за една кутийка бубено семе, m^2	
			In the beginning of instar В началото на възрастта	In the end of instar В края на възрастта
I	26–27	85–90	0.2	0.8
II	26–27	85–90	1	2
III	25–26	75–80	3	5–6
IV	23–24	70–75	8	10
V	22–23	70–75	12–15	22–25

Results and discussion

Data related to the eggs hatchability, presented in Table 1, showed that both tested hybrids registered higher values of this indicator in comparison to the control Super 1 x Hesa 2. The difference in the average values between Vratsa 63xLine22 x Nig2xMerefa6 and Super 1 x Hesa 2 was 2.29% in favor of the new hybrid. Comparing Nig2xMerefa6 x Vratsa 63xLine22 and Super 1 x Hesa 2, the registered difference was 2.03%. There was insignificant difference between both new hybrids – 0.26%. Furthermore, in 2021 there was a slight increase in the values of this indicator for both tested hybrids. In the same year it was reported a decrease for the control Super 1 x Hesa 2.

Taking into account the examined hybrids, the larval period duration (Table 1) characterizing the period of silkworm feeding with mulberry leaves, namely from their first feeding to the climbing on shrubs in large numbers for cocoon enlacing, varied to a considerably low extent. The common duration of the larval period duration had lower values for the new hybrids, while the control was observed to have a higher value of this indicator. One of the goals in silkworm breeding is to shorten the larval period duration, which can lead to shorter time for larvae feeding. The new hybrids enlace cocoons for 26 days averagely (or 624 h), and the control – for 26.5 days (or 636 h). In 2021 it was observed that the larva stage was shorter – for the new hybrids it was shorter with 48 h compared to 2020, and for the control it was shorter with 72 h.

The beginning of the fifth instar was assumed to be the day and hour of the first feeding after silkworm waking from the fourth sleep, and the end of the stage – the day and hour of feeding stay and silkworm shrub climbing. The duration of the fifth instar of the new hybrids showed lower values in comparison to the control. Both new hybrids had average duration of the fifth stage of 213 h, while the control had duration of 227.5 h. There was a decrease in this indicator in 2021 compared to 2020. The decrease for both hybrids was with 6 h, and for the control – with 25 h. One of the goals in silkworm selection is the creation of hybrids having lower duration of the larva instar and lower duration of the fifth instar, correspondingly. It, in turn, leads to a shorter period of silkworm feeding and a shorter period where manual work is needed.

Statistical analysis was performed against the hybrid Super 1 x Hesa 2. The quantitative characters analyzed are presented in Table 2:

The pupation rate of the three hybrids remained relatively high – over 96% during the whole study period. Data related to the average values of pupation rate showed that the control

Table 2. Biological characters on new hybrid silkworms
Таблица 2. Биологични характеристики на новосъздадени хибриди копринени буби

	Eggs hatchability, % Люпимост , %			Larval period duration, h Продължителност на ларвения стадии, h			V–th instar duration Продължителност на V–та възраст		
Hybrid Хибрид	2020	2021	`x	2020	2021	`x	2020	2021	`x
Vratza 63xLine22 x Nig2xMerefa6 Враца 63xЛиния22 x Nig2xМерефа6	98.17	98.99	98.58**	648	600	624	216	210	213**
Nig 2xMerefa6 x Vratza 63xLine22 Nig2 xМерефа6 x Враца 63 x Линия22	98.07	98.57	98.32**	648	600	624	216	210	213**
Super 1 x Hesa 2 Супер 1 x Хеса 2	96.57	96.01	96.29	672	600	636	240	215	227.5

**P < 5%; **P < 1%; ***P < 0.1%*

Super 1 x Hesa 2 had lower values than both tested hybrids. The difference in values between Vratsa 63xLine22 x Nig2xMerefa6 and Super 1 x Hesa 2 was under 1%, namely – 0,69%. On the other hand, the difference in values between Nig2xMerefa6 x Vratsa 63xLine22 and Super 1 x Hesa 2 was 1.33% in favor of the new hybrid. Both new hybrids showed similar average values of this indicator. No significant difference between them was registered; the small difference within 1% would not have considerable influence on cocoon yield.

The present research study presented also data related to the number of normal eggs in 1 g, which was determined through three repetitions by 0.5 g of silkworm eggs. For this indicator data of the average values of Vratsa 63xLine22 x Nig2xMerefa6 correlated with those of Super 1 x Hesa 2. Nig2xMerefa6 x Vratsa 63xLine22 showed higher values than the control – with 2.83 and 6.5 values more than Vratsa 63xLine22 x Nig2xMerefa6.

The percentage of the good-quality cocoons is an indicator, which is determined immediately after the cocoon gathering and cleaning. The cocoons are categorized according to: good-quality cocoons (with a living pupa and without big defects of the cocoon coat), couple cocoons and scrap. After sorting, each cocoon category is being weight. Its percentage of the total yield is being estimated.

Taking into account this indicator, the values of the three hybrids were very high within the range of 98%. Even in 2020 the values were from 99% for the hybrid Nig2xMerefa6 x Vratsa 63xLine22, which was the maximum good quality cocoons that could be received in silkworm breeding.

Statistical analysis was performed against the hybrid Super 1 x Hesa 2. The quantitative characters analyzed are presented in Table 3:

Conclusions

The results of the research study conducted allow us to conclude that the newly created hybrids exceed the regional hybrid Super 1 x Hesa 2 regarding the eggs hatchability and pupation rate character values. Similarly, they have shorter duration of the larval instars and the fifth instar of silkworm growth. These four quantitative characters are of great importance for the high yields of cocoons having a lower production costs obtaining.

References

Ghanipoor, M., Mirhosseini, S. Z., Shadparvar, A., Seidavi, A. R., & Bizhannia, A. R. (2006). Comparison of different selection indices for genetic improvement of

Table 3. Quantitative characters of new hybrid silkworms
Таблица 3. Количествени характеристики на новосъздадени хибриди копринени буби

	Pupation rate, % Жизненост, %			Number of normal eggs in 1 g Брой нормални яйца в 1 g			Good quality cocoons, % Доброкачествени пашкули, %		
Hybrid Хибрид	2020	2021	`x	2020	2021	`x	2020	2021	`x
Vratza 63xLine22 x Nig2xMerefa6 Враца 63хЛиния22 x Nig2xМерефа6	98	97.07	97.535**	1193	1199	1196	98.67	98.83	98.75
Nig2xMerefa6 x Vratza 63xLine22 Nig2xМерефа6 x Враца 63хЛиния22	98.67	97.67	98.17**	1196	1209	1202.5	99	98.83	98.92
Super 1 x Hesa 2 Супер 1 x Хеса 2	97.67	96	96.84	1192	1207.33	1199.67	98	98.27	98.14

*$P < 5\%$; **$P < 1\%$; ***$P < 0.1\%$

economic traits in silkworm (Bombyx Mori L.) lines. *Sericologia*, *46*(2), 137–143. .

Groen, A. F. (1990). Influences of production circumstances on the economic revenue of cattle breeding programmes. *Animal Science*, *51*(3), 469-480. 10.1017/S0003356100012502

Lidanski, T. (1988). Statistical methods in biology and in agriculture (pp. 135-160). *Sofia, Bulgaria*.

Mavvajpour, M., & Seidavi, A. R. (2010). Comparative Study on the Larval Development Duration of 51 Different Peanut Cocoon Strains of Iran Silkworm Bombyx mori (Lepidoptera: Bombycidae) Gene Bank" M. Salehi Nezhad,"SZ. Mirhosseini," S. Gharahveysi. *Asian Journal of Animal and Veterinary Advances*, *5*(4), 234-245.

Mubashar, H., Shakil, A. K., & Muhammad, A. (2010). Evaluation of genetic potential of inbred pure lines of silkworm for breeding and cocoon production in Pakistan. *African Journal of Food Science*, *4*(5), 300-302.

Nacheva, J., & Petkov, N. (1996). Use of mathematical prognostication in the choice initial forms for development of tetrahybrids of the silkworm (Bombyx mori L.). *Animal Science*. 83-86.

Neshagaran, R. H., Seidavi, A., & Gharahveysi, S. (2011). Estimation response to selection in three commercial lines of silkworm (Bombyx mori L.) having peanut cocoon. *Journal of Animal and Veterinary Advances*, *10*(17), 2208-2214.

Petkov, N. (1995) Selection and genetic studies and results of the selection of breeds, lines and hybrids of the silkworm, *Bombyx mori* L., DASthesis, Sofia.

Petkov, N., Grekov, D., & Ramnali, P. (2001). Studies on the Degree of Genetic Divergence for Different Quantitative Traits Between Paremntal Lines of Silkworm, Bombyx mori L., Hybrids. *International Journal of Industrial Entomology*, *2*(1), 79-81. (Korea).

Petkov, N., Natcheva, Y., & Grekov, D. (2001). Inheritance of main productive traits in *Bombyx mori* L., *Journal of Mountain Agriculture on the Balkans, vol. 4*, 4-5, 256-262.

Petkov, N., Nacheva, Y., Tzenov, P., Ignatova, L., & Grekov, D. (1999). New highly productive silkworm, Bombyx mori L. hybrids for commercial cocoon production in Bulgaria. In *18. Congress of the International Sericultural Commission, Cairo (Egypt), 12-16 Oct 1999.*

Petkov, N., & Petkov, Z. (2003). A complex method for testing newly created silkworm (Bombyx Mori L.) hybrids for spring and summer rearings. II. For summer rearing. *Journal of Animale Science*. *5*, 114-117.

Seidavi, A. R. & Bizhannia, A. R. (2008 a). Principles and methods of silkworm breeding improvement. Rasht: Haghshenas; p. 150.

Seidavi, A. (2010). Relationship between season and efficiency of individual selection in six peanut and oval lines of silkworm. *International Journal of Engineering and Technology*, *2*(2), 211–214..

Seidavi, A. (2010). Estimation of genetic parameters and selection effect on genetic and phenotype trends in silkworm commercial pure lines. *Asian Journal of Animal and Veterinary Advances*, *5*(1), 1-12.

Seidavi, A. (2010). Investigation on effect of individual selection based on cocoon weight on additive genetic value and selection index value in six commercial silkworm pure lines. *World Journal of Zoology*, *5*(1), 07-14.

Singh, T., & Samson, M. V. (1998). Correlation and heritability analysis in the silkworm Bombyx mori. *Sericologia (France)*. 32:269–273.

Talebi, E., & Subramanya, G. (2009). Genetic distance and heterosis through evaluation index in the silkworm, Bombyx mori L. *World Applied Sciences Journal*, *7*(9), 1131-1137.