

Productive features of New F1 Silkworm Hybrids *Bombyx mori* L.

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Abstract

The present research study was conducted in the Agricultural University – Plovdiv in the period 2020–2021. The following newly created F1 silkworm hybrids were tested: Vratsa 63xLine22 x Nig2xMerefa6; Nig2xMerefa6 x Vratsa 63xLine22. The industrial hybrid Super1 x Hesa2 was used as a control. The present research paper aimed at examining the values of the following important quantitative features of the new silkworm tetra-hybrids: fresh cocoon weight; shell weight; shell ratio; the good quality cocoons; the percentage of dry from raw cocoons. It was established that both new hybrids had higher values for the quantitative features compared to the used control variant. With relation to the fresh cocoon weight, the shell weight, the silkiness and the good quality cocoons, the hybrid Nig2xMerefa6 x Vratsa 63xLine22 had the highest indicators, followed by Vratsa 63xLine22 x Nig2xMerefa6, and Super1 x Hesa2 being last. It was concluded that both newly created hybrids could be recommended as appropriate for use into practice.

Key words: *heritability, production potential, hybrids, genetic parameters, silkworm, Bombyx mori* L.

Продуктивни характеристики на новосъздадени F1 хибриди на черничевата копринена пеперуда *Bombyx mori* L.

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Резюме

Проучването е проведено в Аграрен университет – Пловдив през периода 2020–2021 г. Изпитани са новосъздадените F1 хибриди буби Враца 63xЛиния22 x Nig2xМерефаб и Nig2xМерефаб x Враца 63xЛиния22, а за контрола е използван промишленият хибрид Super 1 x Hesa 2. Целта на изследването е да се проучат стойностите на важните количествени признаци средно тегло на суров пашкул, средно тегло на копринена обвивка, процент свilenост, структурата на суровите пашкули и процент на сухи от сурови пашкули при новосъздадените тетрахибриди буби. Установено е, че и двата нови хибрида имат по-високи показатели в сравнение с използвания контролен вариант. С най-добри показатели по отношение средно тегло на суровия пашкул, средно тегло на копринената обвивка, свilenост и структура на суровите пашкули се отличава Nig2xМерефаб x Враца 63xЛиния22, следван от Враца 63xЛиния22 x Nig2xМерефаб

и накрая Super 1 x Hesa 2. Направен е изводът, че двата новосъздадени хибрида могат да се препоръчат за използването им в практиката.

Ключови думи: наследственост, продуктивен потенциал, хибриди, генетични показатели, черничева копринена пепруда, *Bombyx mori* L.

Introduction

The silkworm (*Bombyx mori* L.) is one of the most useful farm insects that has contributed to a great extent for the human cultural development, more specifically for supplying the finest material for people's clothing.

One of the challenges that selectionists face is the transition of desired features from the parental forms to the next offspring. Taking into account the above mentioned features, the selectionists choose the parental forms from different silkworm populations (Bindroo & Shunmugan, 2014). According to (Jolly et al., 1989), the breeds/lines created with the desired genes are used in the reproduction programs and in the creation of new hybrids with improved characteristics.

The right choice of parental forms leads to qualitative and quantitative improvement of the new hybrids. (Neshagaran, 2016).

The most important economical features related to silk production include: weight of the cocoon (g), weight of the silk coat (g), duration of the larva period (h), length of the silk thread (m), thickness of the thread (Kumaresan et al., 2003).

It is necessary one to be aware of the relationships between the quantitative features of silkworm and their significant role in the production industry. For example, the producers of silk worm seeds have interest to obtain a greater number of normal eggs from a kilogram of implemented tribal cocoons. On the other hand, farmers are interested in hybrids that suffer less from diseases, are more resistant to temperature variations, give high yield of cocoons for a shorter period of time. The producers from the textile industry who deals with silk winding off

and cloth making recognize the length of cocoon thread and the percentage of cocoon winding off as the most important. According to Tribhuwan (2011), the selection of new hybrids leads to constant change in the ratio of different genes inherited from the initial forms.

A number of authors (Ramesha et al., 2009; Seshagiri et al., 2009; Reddy et al., 2010; Kumar and Sankar Naik, 2011) have reported that F1 hybrids are more productive and resistant to diseases and stress factors compared to the pure breeds. Furthermore, the new hybrids could be bred easier if the appropriate technology is applied.

The present research study aimed at examining some important quantitative features of the newly created silkworm tetra-hybrids, such as: fresh cocoon weight, shell weight, shell ratio, good quality cocoons, percentage of dry from raw cocoons. The obtained information would give us the answer whether the new hybrids could be recommended for use into practice in order to improve the production effectiveness.

Materials and methods

The study was conducted in the Agricultural University of Plovdiv in the period 2020–2021. The following F1 hybrids were tested and examined: Vratsa 63xLine22 x Nig2xMerefa6 and Nig2xMerefa6 x Vratsa 63xLine22, as well as the industrial hybrid Super1 x Hesa2, which was used as a control.

Each hybrid was examined at optimum breeding conditions in two repetitions by 300 silkworms, counted after the second sleep.

The breeding conditions are presented in Table 1.

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

Data were processed statistically through a one-factor dispersion analysis (Lidanski, 1988). The values of the following important quantitative features were registered: fresh cocoon weight, shell weight, shell ratio, good quality cocoons, as well as percentage of dry from raw cocoons. The values of these features were estimated by the commonly accepted methods (Grekov et al., 2005).

Results and discussion

The data obtained are presented in Table 2 and 3. Taking into account the fresh cocoon weight, it could be noted that during the years of study there was gradual increase in this value for both new hybrids, as well as for the control Super1 x Hesa2. In 2021 the hybrid Vratsa 63xLine22 x Nig2xMerefa6 had higher fresh cocoon weight averagely with 66,25 mg compared to 2020, followed by Nig2xMerefa6 x Vratsa 63xLine22 with difference of 28,75 mg and the control variant Super 1 x Hesa 2 with difference of 22,25 mg. Regarding the average values, it was statistically proven that both new hybrids exceeded the values of the control, as for Vratsa 63xLine22 x Nig2xMerefa6 there were 2233,13 mg, which was 122 mg more than the control Super 1 x Hesa 2 (2111,13 mg). The values of Nig2xMerefa6 x Vratsa 63xLine22 also exceeded those of the control with 193,25 mg.

Taking into account the shell weight (Table 2), the tendency for increased values in both years of study was observed only for the hybrid Vratsa 63xLine22 x Nig2xMerefa6 with 8,32 mg more. In 2021 there was decrease in these values, as the most insignificant decrease was observed for the control Super 1 x Hesa 2 – 0,88 mg, followed by the hybrid Nig2xMerefa6 x Vratsa 63xLine22. Despite the registered slight decrease of the shell weight, both new hybrids kept their relatively higher values compared to the control Super 1 x Hesa 2, as the greatest difference was reported between the hybrid Nig2xMerefa6 x Vratsa 63xLine22 and the control Super 1 x Hesa 2 – with 76,73 mg more than the control. The value of the hybrid Vratsa 63xLine22 x Nig2xMerefa6 was 494,16 mg, and for the control – 444,56 mg, having difference between them – 49,6 mg. Comparing both hybrids on the grounds of the above mentioned indicators, Nig2xMerefa6 x Vratsa 63xLine22 showed slightly higher values than Vratsa 63xLine22 x Nig2xMerefa6, as the difference between both breeds was 27,13 mg. The highest fresh cocoon weight was reported for Nig2xMerefa6 x Vratsa 63xLine22, as the difference of the average value between the hybrid and the control was 76,73 mg.

Fresh cocoon weight, shell weight and shell ratio of the new tetra-hybrids are presented in Table 2.

Statistical analysis was performed against the hybrid Super 1 x Hesa 2.

Shell ratio is a feature being of a great importance for silk production. The difference of the average values between the control and the hybrid Vratsa 63xLine22 x Nig2xMerefa6 was 1,03%, and between the control and the hybrid Nig2xMerefa6 x Vratsa 63xLine22 it was 1,62%. The difference between both new hybrids was barely under 1%. In both testing years the highest values were registered for the hybrid Nig2xMerefa6 x Vratsa 63xLine22, followed by Vratsa 63xLine22 x Nig2xMerefa6 and Super 1 x Hesa 2.

The value of the structure of dry cocoons (good quality cocoons) expressed in percents (Table 3) for the three hybrids remained high – over 95%, and the differences observed during the study were under 1%. During the testing years both new hybrids had very close values –

within the limits of 98%. The control Super 1 x Hesa 2 registered a lower value compared to the other two hybrids.

Structure of dry cocoons and percentage of dry from raw cocoons are presented in Table 3.

Statistical analysis was performed against the hybrid Super 1 x Hesa 2.

Taking into account the percentage of dry from raw cocoons, the hybrid Vratsa 63xLine22 x Nig2xMerefa6 showed the highest value of 41,38. There was increase in this value for the hybrid in 2021 compared to 2020, and for the rest two hybrids this value decreased in 2021 compared to 2020. Nevertheless, the three hybrids had values over 40%.

The above mentioned analyses lay the grounds of future research studies directed to the issues

Table 2. Productivity of new hybrid silkworms

Таблица 2. Продуктивност на нови хибриди буби

Hybrid Хибрид	Fresh cocoon weight, mg Тегло на суров пашкул, mg			Shell weight, mg Тегло на копринената обвивка, mg			Shell ratio, % Свиленост на сурови пашкули, %		
	2020	2021	`x	2020	2021	`x	2020	2021	`x
Vratsa 63xLine 22xNig 2xMerefa 6 Враца 63xЛиния 22xNig2 x Мерефа 6	2200	2266.25	2233.13***	490	498.32	494.16**	22.43	22.48	22.46**
Nig 2xMerefa 6xVratsa 63xLine 22 Nig2 x Мерефа 6 x Враца 63xЛиния 22	2290	2318.75	2304.38***	525	517.57	521.29***	23.1	22.99	23.05***
Super 1 x Hesa 2 Супер 1 x Хеса 2	2100	2122.25	2111.13	445	444.12	444.56	21.53	21.32	21.43

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

Table 3. Technological features of newly created hybrid silkworm

Таблица 3. Технологични признаци на новосъздадени хибриди буби

Hybrid Хибрид	Structure of dry cocoons Структура на сухите пашкули, (% доброкачествени)			Percentage of dry from raw cocoons Процент на сухи от сурови пашкули (реза)		
	2020	2021	`x	2020	2021	`x
Vratsa 63xLine 22xNig 2xMerefa 6 Враца 63xЛиния 22xNig2 x Мерефа 6	98.25	98.25	98.25*	40.98	41.77	41.38
Nig 2xMerefa 6xVratsa 63xLine 22 Nig2 x Мерефа 6 x Враца 63xЛиния 22	98.5	98.32	98.41*	41.01	40.92	40.97
Super 1 x Hesa 2 Супер 1 x Хеса 2	97.5	97.97	97.74	41.02	40.77	40.90

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

whether these Bulgarian hybrids could be bred in other climatic conditions in different countries around the world aiming at answering the market demands.

Conclusions

With regards to the growing demand of natural threads and the lowering production of silk worldwide, it can be noted that both newly created hybrids could be recommended for their use into practice. It was proven from the conducted study that both hybrids had higher indicators compared to the control variant. With relation to the fresh cocoon weight, shell weight, shell ratio and the good quality cocoons, the highest indicators were reported for the hybrid Nig2xMerefa6 x Vratsa 63xLine22, followed by Vratsa 63xLine22 x Nig2xMerefa6, and Super 1 x Hesa 2 taking the last place.

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