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Performance of single and double hybrids of silkworm (*Bombyx mori* L.) for biological traits on mulberry

Sangle KV, CB Latpate and YB Matre

Abstract
The experiment was carried out to study the "Performance of Biological traits of single and double hybrids of silkworm (*Bombyx mori* L.) on Mulberry " at Sericulture Research Unit, Department of Agricultural Entomology, College of Agriculture, VNMKV, Parbhani during 2020 – 2021. The variety V-1 was utilized during experiment. The hybrids *viz*., BL67 x CSR5, SHP5 x DHP5, DHP5 x SHP5, (CSR16 x CSR17) x DHP5, (CSR2 x CSR40) x (S8 x CSR16), (CSR46 x CSR47) x (S8 x CSR16), (S8 x CSR16) x (CSR50 x CSR51) and (CSR2 x CSR4) x (G3 x G2) were utilized as treatments. Among the different hybrids reared, the bivoltine hybrid (CSR16 x CSR17) x DHP5 performed better for biological characters, larval duration (24.25 days) and effective rate of rearing (93.70 per cent) over rest of treatments and hybrid SHP5 x DHP5 performed better for hatching (91.53%) and pupal duration (9.53 days).

Keywords: Biological, hybrids, silkworm, mulberry

Introduction
Sericulture is the practise of raising silkworms for the purpose of producing raw silk. Mulberry silkworm (*Bombyx mori*), Tassar silkworm (*Antheracea mylitta*), Muga silkworm (*Antheracea assamensis*), and Eri silkworm (*Antheracea assamensis*) are the four species of silkworm that produce natural silk (*Philosemia ricini*). Mulberry silk is one of the most outstanding types of silk, accounting for 59 percent of total global production. (Anonymous, 2001) [1]. The silkworm breeds are crucial for good cocoon yield and silk quality. For the first time, the introduction of the hybrid 'CSR2 x CSR4' in 1997 revolutionized the Indian sericulture sector in the production of high-quality silk. Many productive and robust bivoltine hybrids (CSR hybrids) are being extensively produced by farmers in South India in recent years, recognising the need of introducing an exclusive bivoltine hybrid to bring quantitative and qualitative development in sericulture. With the advancement of modern silkworm rearing technologies for the tropics, the situation has changed, and multivoltine x multivoltine crosses have been replaced by multivoltine x bivoltine and bivoltine x bivoltine hybrids (Datta, 1984) [3]. If India is to compete successfully in the international market, it must increase the quality of the silk yarn produced by enhancing silk reeling and processing technology. However, the introduction of newer bivoltine silkworm strains, particularly double cross hybrids, is the only way to produce raw silk of worldwide quality. (Dayananda *et al.*, 2011) [4].
India is one of the oldest country practicing sericulture and rearing of polyvoltine silkworm is tradition of the country. The majority of Indian silk is of polyvoltine origin, produced by small-scale operators who cannot compete in terms of quality and uniformity on the international market. As a result, there is a lot of scope for increased production of high-quality silk to meet the needs of power machines, which will only be achievable if bivoltine sericulture is successfully introduced on a broad scale, together with a modern reeling unit. It becomes vital to evolve bivoltine breeds that are suitable to farmers' conditions, such as weak management levels, poor quality mulberry leaves, and variable microclimatic conditions. (Quadri *et al*., 2013) [9].
In World during 2019-20 total mulberry Silk Production was 109,094.5 MT. In Maharashtra state during 2019-20 the Production of raw silk was 228 MT. (Director of Sericulture, Nagpur). There are 30 silk-producing countries in the world, all of which are located between 29 and 42 degrees north latitude. Maharashtra is one of India's 22 non-traditional states that practise sericulture.

To enhance sericulture activity in Maharashtra, a special directorate of sericulture was established in Nagpur in September 1997.

Material and Methods

The purpose of this assessment was to study the "Performance of Biological traits of single and double hybrids of silkworm (*Bombyx mori* L.) on Mulberry" at Sericulture Research Unit, Department of Agricultural Entomology, College of Agriculture, VNMKV, Parbhani during 2020–2021.

The rearing house and rearing appliances were disinfected with Sanitech (ClO_2) solution (500 ppm ClO2 + 0.5% slaked lime) to make them free from pathogens before rearing. The trays containing egg sheets were stored in cool place in rearing house. On attaining the blue growth stage, the egg sheets were placed in plastic incubation tray and covered by black piece of cloth called as black boxing and left undisturbed for 24 hours for uniform growth of embryo, after which the eggs were exposed to bright tube light for one hour for uniform hatching. The newly hatched worms were fed cut pieces of tender fresh mulberry leaves variety V-1. Timing of the feeding was fixed at 7 hours, 11 hours, 16 hours and 20 hours in a day. The silkworm moults for four times during its larval growth phase (five instars).

After the ripe worms were identified when they appeared translucent with a creamy colour, stopped eating, crept towards the periphery of the trays, and attempted to spin the cocoon; these worms were hand-picked and preserved on the mountages. Within 48 to 72 hours, the larvae spun the cocoons. Until it emerges, the pupa stays inside the cocoon. On the fifth day after the worms were released from the mountages, cocoons were harvested.

Result and Discussion

The hatching percentage of eggs of mulberry silkworm hybrids were recorded in between 85.25 to 93.34 per cent. The significantly highest The percentage of hatching was reported in SHP5 x DHP5 (93.34 per cent). The treatment BL67 x CSR5 (85.25 per cent) showed significantly lower hatching per cent than control treatment (CSR2 x CSR4) x (G3 x G2) (89.23 per cent).

The hybrid (CSR16 x CSR17) x DHP5 had demonstrated the shortest larval duration (24.25 days) and found significantly superior over rest of the treatments. Only two hybrids BL67 x CSR5(25.83 days) and SHP5 x DHP5(25.42 days) shown that non-significant larval duration than control treatment (CSR2 x CSR4) x (G3 x G2) (1.89 g). Munemanik *et al.* (2018) [7] observed the larval duration of hybrid CSR16 x CSR17 (23.42 days).

The pupal duration varies in the range of 9.53 to 10.94 days. Minimum pupal duration was observed in the hybrid SHP5 x DHP5 (9.53 days). Maximum pupal duration was observed in (S8 x CSR16) x(CSR50 x CSR51) (10.94 days) over rest of the treartments. Maske (2020) [6] observed the pupal duration in her experiment in DHP5 (9.89 days) and hybrid S8 x CSR16 (10.38 days).

The maximum fecundity observed in hybrid DHP5 x SHP5 (489.33) and minimum fecundity observed in hybrid BL67 x CSR5 (434). The all other hybrids were non-significant for fecundity as compared to control treatment (CSR2 x CSR4) x (G3 x G2) (483.33). Bobade *et al.* (2019) [2] observed the maximum fecundity in hybrid CSR16 x CSR17 (559.33) and DHP5 (480).

Table 1: Performance of single and double hybrids of silkworm (*Bombyx mori* L.) for Egg hatching, Larval Duration, Pupal Duration, Fecundity, Moth Emergence and Effective rate of Rearing

Tr. No.	Treatments	Egg hatching (%)	Larval Duration (in days)	Pupal Duration (in days)	Fecundity (No.)	Moth Emergence (%)	Effective rate of Rearing (%)
T_1	BL67 x CSR5	85.25	25.83	10.71	434.00	88.72	83.01
T_2	SHP5 x DHP5	93.34	25.42	9.53	440.00	91.95	88.60
T_3	DHP5 x SHP5	90.81	25.17	9.61	489.33	92.37	90.95
T_4	(CSR16 x CSR17) x DHP5	91.53	24.25	10.60	484.67	94.73	93.70
T_5	(CSR2 x CSR4) x (S8 x CSR16)	91.22	25.25	10.86	459.33	95.02	89.47
T_6	(CSR46 x CSR47) x (S8 x CSR16)	92.89	24.83	10.41	461.67	94.58	92.67
T_7	(S8 x CSR16) x (CSR50 x CSR51	92.89	24.33	10.94	458.67	94.38	90.93
T_8	(CSR2) x CSR4) x (G3 x G2)(C)	89.23	25.50	10.43	483.33	92.18	86.94
	Mean	90.23	25.07	10.38	463.87	91.94	89.06
	SE(M)	0.686	0.144	0.273	11.828	1.038	1.013
	CD at 5%	2.101	0.442	0.835	36.224	3.180	3.102

The performance of single and double hybrids for moth emergence was varied in the range of 88.72 to 95.02 per cent. Highest moth emergence was recorded in double hybrid (CSR2 x CSR4) x (S8 x CSR16) (95.02 per cent) which was much better than the rest of the field treatments. All single hybrids BL67 x CSR5 (88.72 per cent), SHP5 x DHP5 (91.95 per cent) and DHP5 x SHP5 (92.37 per cent) were non-significant values for performance of moth emergence related to control treatment. Maske (2020) [6] observed the moth emergence in hybrid CSR2 x CSR4(94.83 per cent), S8 x CSR16(94.75 per cent).

Maximum effective rate of rearing recorded in hybrid (CSR16 x CSR17) x DHP5 (93.70 per cent). Whereas, the hybrid BL67 x CSR5 (83.01 per cent) recorded minimum effective rate of rearing which was poor than control treatment. Bobade *et al.* (2019) [2] observed the highest effective rate of rearing in bivoltine hybrid CSR16×CSR17 (95.16 per cent) which was significantly superior over rest of hybrids followed by in DHP5 (92.99 per cent) which was at par with each other.

Conclusion

These research finding concluded that among all the eight treatment used for rearing T_4 i.e. (CSR16 x CSR17) x DHP5 given the best result for larval duration and effective rate of rearing and T_2 i.e. SHP5 x DHP5 performed better for hatching and pupal duration. In aspect to better rearing of silkworm hybrids, (CSR16 x CSR17) x DHP5 was found to outperform over all treatments.

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