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Original Research Article

Studies of the Biology and Economic Traits of Mulberry (*Bombyx mori* L.) Double CSR Hybrids on Different Mulberry Variety

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A B S T R A C T

The experiment was conducted at Sericulture Research Unit, V.N.M.K.V, Parbhani, during 2019-20 laid in Randomized Block Design with eight treatments, replicated thrice. The eight improved mulberry varieties *i.e.* Kanva-2, V-1, S-13, S-36, BER-779, G- 2, G-4, BER-776 were introduced at sericulture research unit, VNMKV, Parbhani, Maharastra. During the study it was observed that highest hatching percentage of hybrid for variety BER-776 (97.18 per cent), G-2 (96.95 per cent), minimum larval duration observed for hybrid larvae which fed on variety G-4 (21.66 days), highest fecundity observed for hybrid fed on variety BER-776 (531.12 eggs), highest 10 mature weight observed for larvae feed on variety G-4 (39.887 g), the double hybrid larvae fed on variety BER-776 shown the lowest pupal duration (09.58 days), the double hybrid fed on variety V-1 shown highest cocoon weight (1.295 g), the double hybrid fed on variety V-1 shown the highest shell weight (0.291 g), highest shell ratio observed for hybrids fed on varieties S-36 and G-4 (22.85 per cent) and (22.43 per cent), highest filament length observed for variety V-1 (993.33 m), highest filament weight of V-1 (0.340 g), highest denier of V-1 (3.11 per cent), higher cocoon yield S-36 (17.436 kg), highest ERR of variety G-2 (94.47 per cent), moth emergence V-1 (96.53 per cent), G-4 (95.70 Per cent) compare to other varieties.

Keywords

Silkworm, Mulberry varieties, Cocoon, Hybrid

Introduction

Silk is the most elegant textile in the world with unparalleled grandeur, natural sheen and inherent affinity for dyes, high absorbance, light weight, soft touch and high durability silk is known as the "Queen of Textiles" in the world. Sericulture industry combines the attributes of both agriculture and industry. It comprises three distinct activities *viz.* cultivation of mulberry, rearing of silkworms and reeling of cocoons. The golden yellow coloured Muga silk is produced only in Assam throughout the world. In India silk producing states are Karnataka, Andhra - Pradesh, West Bengal, Tamil Nadu, Jammu

Kashmir, Bihar, Madhya Pradesh and Uttar Pradesh. Out of these Karnataka produce 45% of the countries total raw silk production and 1st rank in India.

Mulberry plant is the first choice of mulberry silkworm. It was believed that plant is native of India or China particularly from lower slopes of Himalayas. In India Maharashtra is leading state among the 22 non-traditional states practicing sericulture. A separate directorate of sericulture at Nagpur has been established in September 1997 to increase the sericulture activity in Maharashtra state.

In India, about 97% of the raw mulberry silk was produced in the five Indian states namely Karnatak, Andhra-Pradesh, Tamil Nadu, West Bengal and Jammu & Kashmir (Mulberry cultivation and utilization in India 2016-17). Anonymous (2017)[1] Where Maharashtra produces 373 MT silk in year 2017-18. Sericulture is well established agro based industry, which is cost effective and remunerative. The specialty of the state is that, it undertakes 98% of bivoltine sericulture and stood first among non-traditional states and one of the potential state in India for silk (Geiger, 2000) [2].

The growth and development of the larvae and subsequently cocoon production are greatly affected by nutritional quality of mulberry leaves. (Krishswami, 1979) [3]. A deficiency of certain nutrients in leaves causes some changes in the composition of metabolic activity of larval body (Ito, 1972). The importance of good nutrient during first and second instars and its effect on subsequent instar and cocoon production has been recognized both in India and outside (Takeuchi, 1960) [4].

Silkworm larva prefers to consume the leaves that contain high moisture and less dry matter (Benchamin and Jolly, 1986) [5]. Water content of leaf play a significant role on food utilization and growth in phytophagous insects (Periaswamy, 1994) [6]. The quality of mulberry leaves vary significantly with factor such as soil fertility, agronomical practices, planting system and environmental condition (Bongale *et al.*, 1991). Other than this leaves quality also affected by age of maturity environmental factors.

Materials and Methods

The experiment was conducted in Randomized Block Design with eight treatments and three replications. Each replication consisted of 100 silkworms. The field experiment was undertaken during August to December 2019-20 "Studies of the biology and economic traits of mulberry (*Bombyx mori* L.) Double CSR hybrids on Different Mulberry variety" The eight improved mulberry varieties *i.e.* Kanva-2, V-1, S-13, S-36, BER-779, G- 2, G-4, BER-776 were introduced at sericulture research unit, VNMKV, Parbhani, Maharastra. Krishnswami (1978) described the improved technology of silkworm rearing and it was adopted in the present investigation. The rearing house and all rearing appliances were disinfected with sanitech (CLO_2) solution (500 ppm CLO_2 +0.5% slaked lime) to make them free from pathogen before rearing. Paper Sheets of disease free laying's of silkworm races were procured from Central Sericulture Research and Training Institute, Mysore and were incubated at 25+1 degree and 75+5% relative humidity. The egg sheet were sprayed out in a single layer in the rearing tray and covered with the paraffin wax coated paper in rearing stand and made the black boxes for each hybrids. The boxes kept under tray and covered with black cloth 48 hour before hatching and on the day of hatching should keep under light for uniform hatching. The newly hatched egg kept in different trays for easy feeding, newly

hatched larvae of silkworm hybrids were fed with chopped pieces of fresh tender mulberry leaves of V-1, Kanwa-2, S-36, S-13, G- 2, BER-779,BER-776,G-4variety. The leaves were chopped into small pieces of 0.5 to 1.5 cm^2 and sprinkled over the newly hatched worms for their feeding. The feeding was given for four times in a day. The rearing trays were cleaned once after I^{st} moult and twice up to II^{nd} moult. The silkworm moults four times during its larval growth period. Its growth completed in five stages. The stage between two moults is called as "instar" and hence there are "five" instars in the life period of silkworm. During moulting the worms cease feeding and hence were not provided any food. Moulting is completed in 20 to 30 hrs. The duration of moult will be change as per the season, after the completion of each moult a bed disinfectant Vijeta @ 4g/39 sq. feet was dusted to control the diseases and feeding was given after half an hour. Later on bed cleaning was undertaken. After the worms full development, the matured worms were identified, as they looked translucent with creamy colour. The matured worms ceased to eat, crawled towards periphery of the trays and tried to spin the cocoons, were handpicked and put on netrika for spinning cocoon. The worms spun the cocoons within 48 to 72hrs. The pupae remained inside.

Results and Discussion

The broad objective of research was to study the biology and economic traits of double silkworm hybrids on mulberry varieties of *Morusalba* and to evaluate the good mulberry variety for feeding. The number of parameters such as Hatching percentage, Fecundity, Larval duration (in days), Pupal duration (in days), weight of ten mature Larvae (g), Single Cocoon weight (g), Single Shell weight (g), Shell ratio (%), filament length (m), filament weight (g), denier, and Cocoon yield/10,000 larvae, effective rate of rearing (ERR), moth emergence (%) were evaluated to study the performance of varieties on biology and economic traits of bivoltine silkworm double hybrid. For the varieties Kanwa-2, V-1, S-13, S-36, G-2, BER-779, BER-776, G-4.

Among the eight varieties hatching percentage was recorded in the double hybrid of silkworm fed on varieties BER-776 (97.18 per cent), G-2 (96.95 per cent), V-1 (95.34 per cent), S-13 (94.42 per cent), S-36 (93.75 per cent) and G-4 (92.98 per cent). The lowest hatching percentage was recorded in hybrid which fed on variety BER-779 (90.21 per cent.) and Kanwa-2 (87.33 per cent).

The highest fecundity was observed in double hybrid fed on varieties BER-776 (531.12 eggs), G-4 (513.63 eggs), S-13 (503.69 eggs), V-1 (500.33 eggs), G-2 (500.32 eggs) and fallowed by varieties S-36 (470.23 eggs), Kanwa-2 (452.15) and BER-779 (426.83 eggs).

The double hybrid larvae had shown the highest 10 mature larval weight fed on varieties G-4 (39.877 g), G-2 (39.807 g), Kanwa-2 (37.834 g), BER-776 (37.560 g), V-1 (38.534 g), S-36 (38.330 g), S-13 (38.234 g) and lowest for variety BER-779 (37.487 g).

The all larvae fed on varieties G-4 (21.66 days), S-13 (21.95 days), S-36(21.80 days), G-2 (22.12 days), V-1 (22.23 days), BER-776 (22.23 days), Kanwa-2 (22.50 days) had shown the lowest larval duration larvae fed on variety BER-779 (22.51 days) shown longest larval duration.

The double silkworm (*Bombyx mori* L.) hybrid shown that the pupal duration was observed lowest for variety BER-776 (09.58 days) and followed by varieties S-36 (10.17),

G-2 (10.40 days), G-4 (10.43 days), S-13 (10.51 days), V-1 (10.68 days), Kanwa-2 (10.80 days). The highest pupal duration was recorded in treatment bivoltine silkworm hybrid which fed on variety BER-779 (11.07 days).

The double hybrid larva fed on varieties V-1 (1.295g), BER-776 (1.231g), BER-779 (1.225 g), G-4 (1.221 g), shown the highest cocoon weight among other varieties. The larvae fed on varieties S-13 (1.207g), S-36 (1.206g), G-2 (1.188 g), Kanwa-2 (1.169 g) shown the lowest value. Sadapal (2015) [8] recorded the lowest larval duration of variety BER-776 (22.09 days) among the other variety which he has used in the treatment which was significant.

The double hybrid fed on the varieties V-1 (0.291 g) followed by S-36 (0.278 g), G-4(0.227 g), BER-776 (0.274 g), S-13 (0.258 g), G-2 (0.228 g) shown the highest shell weight and the lowest was recorded in variety BER- 779 (0.218) and Kanwa-2 (0.211 g). Pawar (2010) [9] recorded the 10 mature weight in the range of 33.35-42.18 gm. Variety V- 1 (42.18 g) shown the highest weight compare to other varieties weight Kanwa-2, S- 36, A-1 and BER-1

The double hybrid highest shell ratio was observed in hybrid which fed on varieties S-36 (22.85 percent) and G-4 (22.43 per cent) followed by V-1 (22.38 percent), BER-776 (22.16percent), S-13 (21.23 percent), G-2 (19.04 percent), Kanwa-2 (18.43 percent) and lowest for hybrids fed on variety BER-779 (17.71 percent).

Parihar (2012) [10] observed that single shell weight in the range of 0.22-0.33 g. The maximum weight recorded of larvae fed on Ananta (0.33 g) and followed by other treatment of varieties. Tekule (2018) [11] reported that the highest shell ratio of hybrid fed on the variety BER-779 (23.05 per cent) followed by Kanwa-2. The present finding are more or less in conformity with the findings of above research workers.

The double hybrid shown highest filament length for hybrid fed on varieties V-1 (993.33 m), S-13 (983.33m), BER-776, G-4 (963.33 m), S-36 (956.67 m), G-2 (920.00 m), Kanwa-2 (893.33 m) and the lowest filament length recorded for variety fed on BER-779 (876.67 m).

The double hybrid shown the highest filament weight for varieties V-1 (0.340 g), S-13 (0.320 g), BER-776 (0.320 g), S-36 (0.300 g), G-2(0.290 g), G-4 (0.280g), Kanwa-2 (0.280 g), BER (0.270 g) among all other varieties. Shirdhone (2011)[12] found the single cocoon weight in the range of 1.68-2.20 g.

The highest weight observed in the leaves of Anata (2.20 g) and lowest in the variety LMP (1.68 g) of the mulberry varieties. Pawar (2010)[9] reported that the cocoon filament length was recorded in the ranges of 608.34 m to 930 m. The longest filament length was recorded in the larvae fed on variety V-1 (930 m) followed by Kanwa-2, S-36, A-1 and other varieties.

The double hybrid shown the highest denier for the varieties V-1 (3.11 %), S-13 (2.96%), BER-776 (2.96%), G-2 (2.87%), Kanwa-2 (2.82%), S-36 (2.79%) and G-4 (2.65%) BER-779 (2.61%), shown the lowest shell value.

The yield/10,000 larvae brushed cocoon yield was observed highest for hybrid fed on varieties S-36 (17.436 kg), S-13 (14.181 kg), G-2 (13.815 kg), V-1 (13.675 kg), BER-776 (13.667 kg), Kanwa-2 (13.411kg), BER-779 (12.834 kg) lowest for the hybrid fed on variety G-4 (12.767kg) (Table 1 and 2).

Table.1 The effect of feeding on different mulberry variety on CF, F, HP, ME, D ERR, PD of bivoltine silkworm (*Bombyx mori* L.) hybrids

Sr.No.	Treatment	Cocoon filament weight (g)	Fecundity (no.)	Hatching percentage (%)	Moth emergence (%)	Denier (%)	Effective rate of rearing (%)	Pupal duration (days)
1.	Kanwa-2	0.280	452.15	87.83	94.39	2.82	92.34	10.80
2.	G-2	0.290	500.32	96.95	95.62	2.87	94.47	10.40
3.	S-13	0.320	503.69	94.42	92.16	2.96	92.84	10.51
4.	S-36	0.300	470.23	93.75	92.13	2.79	91.80	10.17
5.	BER-776	0.320	531.12	97.18	93.47	2.96	92.50	9.58
6.	G-4	0.280	513.63	92.98	95.70	2.65	94.45	10.43
7.	V-1	0.340	500.33	95.34	96.53	3.11	92.73	10.68
8.	BER-779	0.270	426.83	90.21	92.90	2.61	91.97	11.07
	SE+	0.010	13.71	1.009	0.85	0.05	1.056	0.24
	CD@5%	0.020	41.59	3.092	2.57	0.14	2.270	0.71
	CV(%)	3.890	4.870	1.868	1.56	2.81	1.383	3.90

*Angular transformed values

Table.2 The effect of feeding different mulberry varieties on of bivoltine silkworm (*Bombyx mori* L.) hybrids

Sr.No	Treatment	Larval duration (days)	Ten Larval weight (g)	Single cocoon weight (g	Cocoon shell Ratio (%)	Single shell weight (g)	Cocoon yd/10,000 larvae brushed by wt (kg)	Cocoon filament length (m)
1.	Kanwa-2©	22.50	37.834	1.169	18.43	0.211	13.411	893.33
2.	G-2	22.12	38.534	1.188	19.04	0.228	13.815	920.00
3.	S-13	21.95	38.234	1.207	21.23	0.258	14.181	983.33
4.	S-36	21.80	38.330	1.206	22.85	0.278	17.436	956.67
5.	BER-776	22.23	37.560	1.231	22.16	0.274	13.667	963.33
6.	G-4	21.66	39.877	1.221	22.43	0.277	12.767	963.33
7.	V-1	22.23	39.807	1.295	22.38	0.291	13.675	963.33
8.	BER-779	22.51	37.478	1.225	17.71	0.218	12.834	876.67
	SE+	0.36	0.250	0.027	0.56	0.007	0.350	08.40
	CD@5%	1.09	0.764	0.080	1.69	0.010	1.071	25.49
	CV(%)	2.80	1.128	3.931	4.65	4.767	4.335	01.54

*Angular transformed values

Sadaphal (2015) [8] evaluate the performance of the mulberry silkworm hybrids the result revealed that the cocoon yield per 10,000 kg larvae brushed highest for variety V-1 (17.38 kg) and followed by S-36, K-2, Ananta which was at par with each other. The highest ERR was observed in for hybrid fed on variety G-2 (94.47 per cent), G-4 (94.45 per cent), V-1 (92.73 per cent), S-13 (92.84 per cent), BER-776 (92.50 per cent), Kanwa-2 (92.34 per cent), BER-779 (91.97 per cent), S -36 (91.80 per cent) which was followed by and lowest ERR was recorded for variety of bivoltine silkworm hybrid.

The double hybrid shown the highest moth emergence for the hybrid fed on mulberry varieties V-1 (96.53 per cent), G-4 (95.70 per cent), G- 2 (95.62 percent), Kanwa-2 (94.39 per cent), BER-776 (93.47 per cent), BER-779 (92.90 per cent) followed by S-13 (92.16 per cent). The lowest moth emergence was observed for hybrids fed on variety S-36 (92.13 per cent) bivoltine silkworm hybrid.

The cocoon till emergence. The harvesting of cocoon was carried out on the fifth or sixth days of release of worms on netrika for spinning the cocoon. Randomly selected ten cocoons of each treatment were used for recording cocoon parameters.

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