

Comparative studies on the influence of temperature and relative humidity on the cocoon productivity of commercial improved silkworm crossbreeds *Bombyx mori L.*

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Abstract

Crossbreeds of mulberry silkworm (*Bombyx mori L.*) are at some extent disease resistive compared to bivoltine breeds because of breed characteristics like highly sensitive to environmental fluctuations and unable to survive in extreme environmental conditions. Variation in temperature and humidity affects physiology of silkworm which affects pre-cocoon parameters such as larval length and weight as well as post cocoon parameters. The environmental parameters like temperature, light and humidity must be appropriate for quality cocoon production. The present study shows role of temperature and Humidity on the growth and development of silkworm. In this study Comparative rearing performance is recorded in relation with temperature and relative humidity of commercial crossbreeds MV1 x S8 and PM x FC2 (*Bombyx mori L.*) at Department of Zoology, Jaysingpur College, Jaysingpur, District-Kolhapur, State-Maharashtra.

Keywords: MV1 x S8, PM x FC2, Temperature, Relative humidity, Pre-cocoon, post-cocoon parameters

Introduction

Rearing of silkworms for production of raw silk is known as Sericulture or silk farming. China was first to discover silk in about 2700 BC. Silk is called the queen of textiles due to its glittering luster, softness, elegance, durability, and tensile properties. The silk is favored over every single other kind of filaments because of its surprising properties like water permeability, warm protection, coloring effectiveness, and gloss. Traditionally Sericulture in India especially mulberry sericulture has been practiced mostly in southern states i.e. Karnataka, Tamil Nadu and Andhra Pradesh and to a limited extent in West Bengal and Jammu-Kashmir. At present, China and India are the two main largest silk producing countries in the world, contributing more than 65% of the world production annually. India is the largest consumer of raw silk and silk fabrics; Sericulture is an agricultural allied with highly labor intensive and employment generating activity. India is only country which is producer of all the five commercially traded varieties of natural silks namely, Mulberry, Tropical Tasar, Oak Tasar, Eri and Muga (Giridhar *et al.*, 2010) [4]. Fibroin (75%) protein secreted from two salivary glands present in the head of larva converts into continuous filament fiber is called silk, with gum sericin (25%) which compact the two filaments together. The factors which the effect production of silk is environmental factors i.e biotic and abiotic factors. It is also identified that the different temperature regimes affect the spinning period, cocoon quality and reeling parameters (Gowda *et al.*, 2007) [5]. Previous studies have identified that many quantitative characters such as survival and cocoon traits decline sharply when temperature is above 28°C during larval development. This has led to the development of compatible Multivoltine hybrids for rearing throughout the year by utilizing Japanese thermo- tolerant hybrids as breeding resource material (Datta *et al.*, 2001) [2]. Hence, development of a productive breed with high-temperature

tolerance becomes a challenging task to increase multivoltine silk production. This study shows Comparative studies on Influence of Temperature and Relative Humidity on the cocoon productivity of commercial improved silkworm crossbreeds MV1 x S8 with PM x FC2 (*Bombyx mori L.*).

Materials and Methods

The present study was carried out at silkworm rearing facility, Department of Zoology, Jaysingpur college, Jaysingpur during year 2021 and 2022. With continuity of two rearing batches every season (Summer, rainy and winter), standard silkworm rearing Package was adapted (Datta *et al.*, 1996) [3]. A new crossbreed MV1xS8 was developed by CSR&TI, Mysore (Sivaprasad *et al.*, 2016) [8]. It was developed for producing good quality and quantity of raw silk. Cross breed PMxFC2 was developed by same institute (Naseema Begum *et al.*, 2008) [1]. It was developed to have silkworm rearing batches throughout year for farmers. Both breeds are multi-bivoltine (cross breeds). Silkworm larvae were given feed of V1 variety of mulberry leaves. Abiotic factors like temperature and relative humidity were recorded. Post cocoon parameters like Cocoon yield /10,000 larvae brushed, Single cocoon weight, Shell weight, Cocoon shell percent were recorded. (Basavaraja *et al.*, 2005) [6].

Formulas: -

- Single cocoon shell weight (g) = weight of single cocoon (g) – weight of pupa inside (g)
- Cocoon shell (%) = $\frac{\text{Single cocoon shell weight (g)}}{\text{weight of single cocoon (g)}} \times 100$

1. Optimum temperature and humidity requirements for successful silkworm rearing (Rahmathulla *et al.*, 2004) [9]

Abiotic factors	I instar	II instar	III instar	IV instar	V instar
Temperature	27-28°C	26-27°C	25-26°C	22-25°C	22-25°C
Relative humidity	85–90%	85–90%	75–80%	70–75%	70–75%

Result and discussion

Table 1: Change in temperature and humidity during rearing of silkworms in year 2021

2021							
Season	Month	Temperature (°C)		Mean Temperature (°C)	Relative humidity (%)		Mean Relative humidity (%)
		Maximum	Minimum		Maximum	Minimum	
Summer	April	38	22	30	46	34	40
	May	36	21	29	41	37	39
Rainy	July	31	18	25	88	82	85
	August	29	22	26	80	76	78
Winter	December	31	15	23	72	65	69
	January	32	19	26	68	62	65

Table 2: Change in temperature and humidity during rearing of silkworms in year 2022

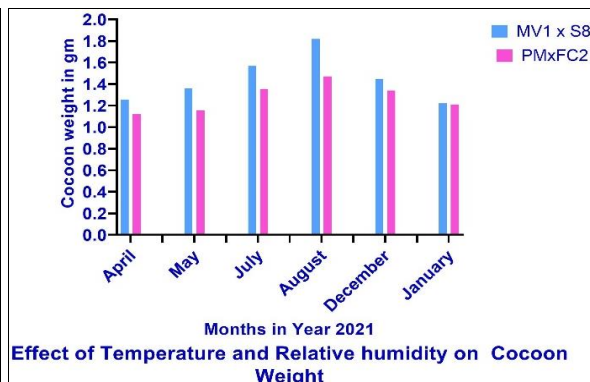
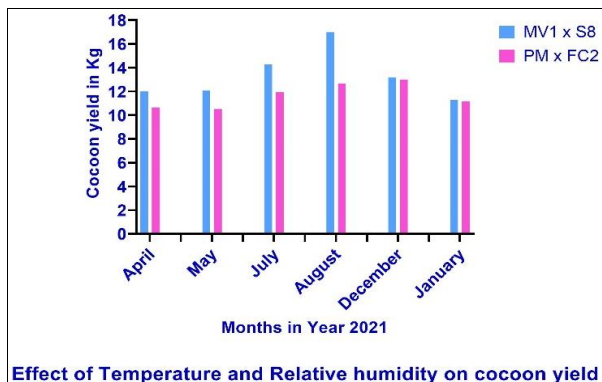
2022							
Season	Month	Temperature (°C)		Mean Temperature (°C)	Relative humidity (%)		Mean Relative humidity (%)
		Maximum	Minimum		Maximum	Minimum	
Summer	April	35	28	32	51	43	47
	May	38	27	33	50	46	48
Rainy	July	32	27	30	82	63	73
	August	30	22	26	78	64	71
Winter	December	31	14	23	65	59	62
	January	33	16	25	81	73	77

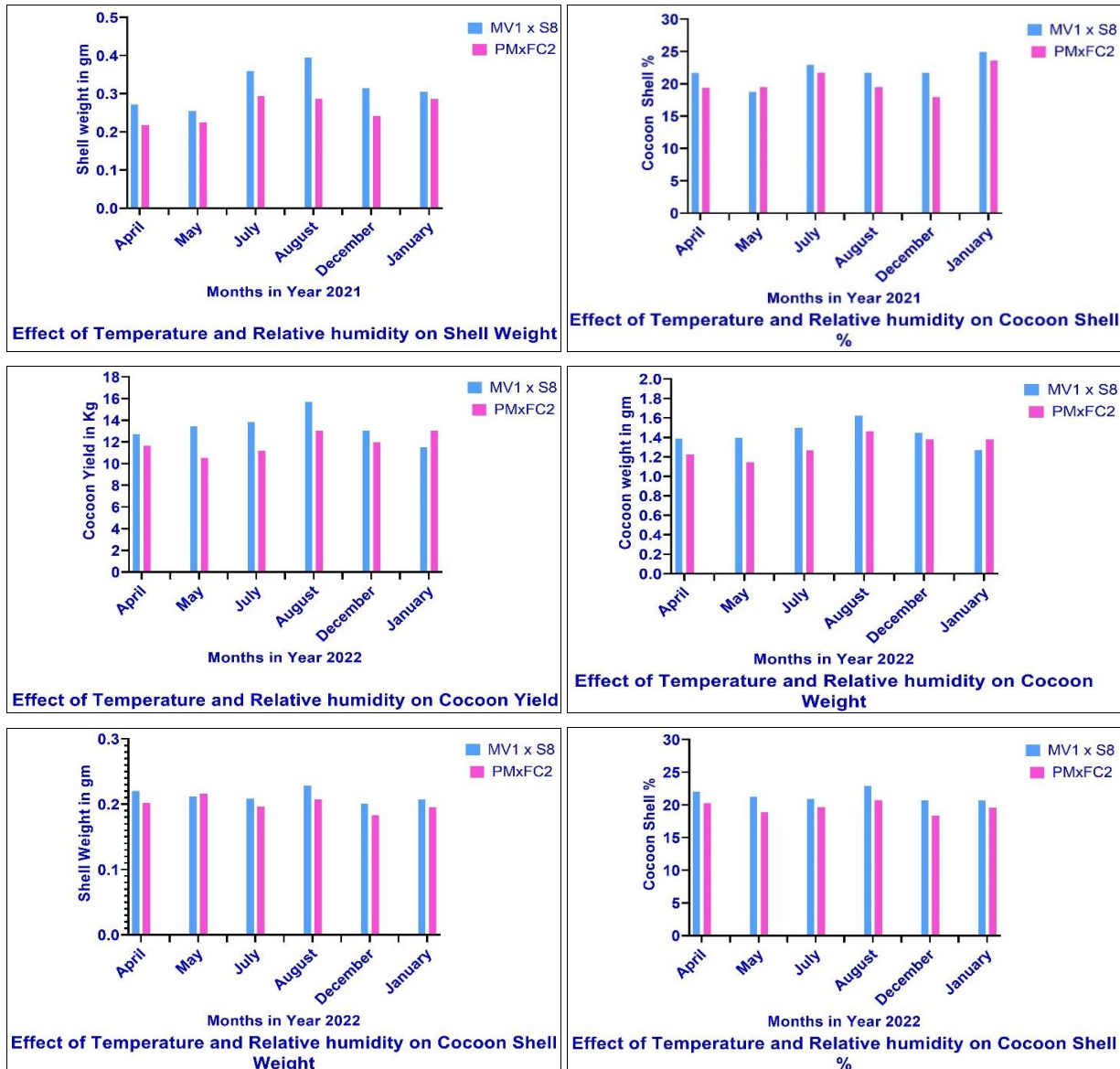
Table 3: Effect of Temperature and Relative humidity on cocoon yield characters in year 2021

Season	Month	Cross breed Combination	Cocoon yield /10,000 larvae brushed		Single cocoon weight	Shell weight	Cocoon shell percent
			No.	Weight (Kg)	(g)	(g)	%
Summer	April	MV1xS8	9568	12.017	1.256	0.272	21.65
		PMxFC2	9482	10.648	1.122	0.218	19.42
	May	MV1xS8	8902	12.088	1.358	0.255	18.77
		PMxFC2	9104	10.524	1.156	0.225	19.46
Rainy	July	MV1xS8	9100	14.268	1.568	0.360	22.95
		PMxFC2	8804	11.920	1.354	0.294	21.71
	August	MV1xS8	9320	16.971	1.821	0.395	21.69
		PMxFC2	8609	12.672	1.472	0.287	19.49
Winter	December	MV1xS8	9110	13.182	1.447	0.314	21.70
		PMxFC2	9682	12.993	1.342	0.241	17.95
	January	MV1xS8	9223	11.279	1.223	0.305	24.93
		PMxFC2	9205	11.147	1.211	0.286	23.61

Table 4: Effect of Temperature and relative humidity on cocoon yield characters in year 2022

Season	Month	Cross breed Combination	Cocoon yield /10,000 larvae brushed		Single cocoon weight	Shell weight	Cocoon shell percent
			No.	Weight (Kg)	(g)	(g)	%
Summer	April	MV1xS8	9188	12.734	1.386	0.220	22.03
		PMxFC2	9502	11.639	1.225	0.202	20.28
	May	MV1xS8	9608	13.422	1.397	0.212	21.20
		PMxFC2	9204	10.538	1.145	0.216	18.88
Rainy	July	MV1xS8	9236	13.826	1.497	0.209	20.92
		PMxFC2	8845	11.197	1.266	0.196	19.63
	August	MV1xS8	9687	15.702	1.621	0.228	22.89
		PMxFC2	8902	13.023	1.463	0.207	20.72
Winter	December	MV1xS8	9008	13.043	1.448	0.201	20.72
		PMxFC2	8701	11.989	1.378	0.183	18.32
	January	MV1xS8	9100	11.538	1.268	0.207	20.71
		PMxFC2	9473	13.044	1.377	0.195	19.53





Change in temperature during three seasons

Maximum mean temperature recorded during May, 2022 was 33°C. Minimum mean temperature recorded in December 2021 & 2022 was 23°C. Change in temperature depends on seasons and rearing in-house facility. All though in-house temperature can be controlled by various measures, it doesn't show difference more than ± 2°C. During experiment temperature was recorded maximum ± 5°C difference than the optimum temperature. Respectively ± 3°C was recorded more than optimum minimum temperature. The optimum temperature for normal growth of silkworms is between 20 °C and 28 °C and the desirable temperature for maximum productivity ranges from 23°C to 28°C. Temperature above 30 °C directly affects the health of the worm (Parrey *et al.*,2018) ^[7].

Change in Relative humidity during three seasons

Maximum mean Relative humidity recorded during July, 2021 was 85%. Minimum mean Relative humidity recorded in May, 2021 was 39%. change in Relative humidity depends on seasons and water content of air in rearing inhouse facility. All though inhouse Relative humidity can be controlled by various measures it doesn't show difference more than ± 20%. During experiment Relative

humidity was recorded maximum ± 5% difference than the optimum Relative humidity. Respectively ± 35% was recorded more than optimum minimum Relative humidity. The optimum Relative humidity for normal growth of silkworms is between 75% and 90%. Relative humidity can affect water content in the feed as well as in the silkworm cocoons.

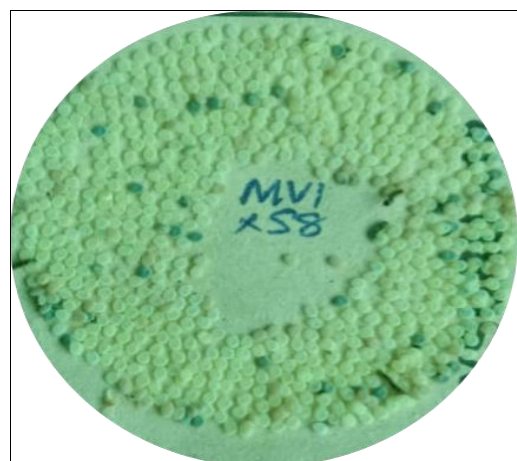


Fig 1: Silkworm eggs



Fig 2: Silkworm Chawki



Fig 3: Mature silkworm larvae



Fig 3: Mature silkworm larvae

Effect of Temperature and Relative humidity on cocoon yield characters

Simultaneously post cocoon parameters like cocoon yield, Single cocoon weight, Shell weight, Cocoon shell percent were recorded.

Cocoon yield in kg

In comparison highest cocoon yield was recorded during month of August, 2021 in MV1 x S8 of (16.971 kg) / 10,000 larvae brushed respectively PM x FC2 given (13.023 kg) / 10,000 larvae brushed in August, 2022. MV1 x S8 showed minimum cocoon yield in month of January, 2021 (11.279 kg) / 10,000 larvae followed by PM x FC2 of May, 2021 (10.524 kg) / 10,000 larvae.

Single cocoon weight

In comparison highest Single cocoon weight was recorded during month of August, 2021 in MV1 x S8 of (1.821 g) respectively PM x FC2 showed (1.472 g) in same month. MV1 x S8 showed minimum Single cocoon weight in month of April, 2021 (1.256 g) followed by PM x FC2 of (1.122 g).

Shell weight

In comparison highest Shell weight was recorded during month of August, 2021 in MV1 x S8 of (0.395 g) respectively PM x FC2 showed (0.294 g) in month July, 2021. MV1 x S8 showed minimum Shell weight in month of December, 2022 (0.201g) followed by PM x FC2 of (0.183 g).

Cocoon shell percent

In comparison highest Cocoon shell percent was recorded during month of January, 2021 in MV1 x S8 of (24.93%) respectively PM x FC2 showed (23.61%) in same month. MV1 x S8 showed minimum Cocoon shell percent in month of December, 2022 (20.71 %) followed by PM x FC2 of (17.95 %) in December 2021.

Overall comparative study of both breeds

Both the breeds showed very good post cocoon characteristics. Besides, both breeds are robust and can be tolerant to highly fluctuating temperature and relative humidity. From above results breed MV1 x S8 showed more cocoon yield than PM x FC2, respectively MV1 x S8 showed high Single cocoon weight, Shell weight, Cocoon shell percent then PM x FC2 breed. As we know both breeds can be reared throughout the year, but MV1 x S8 can be considered best as compared to PM x FC2.

Conclusion

From above result and discussion, we came to conclude that MV1 x S8 Improved crossbreed can be reared throughout the year in various fluctuating climatic factors like temperature and relative humidity in comparison with PM x FC2. For better quality and quantity farms from Maharashtra especially from Kolhapur district can have rearing of MV1 x S8 as a better alternative to other hybrids and cross breeds.

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