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Studies on the seasonal response of two bivoltine hybrid varieties of mulberry silkworm, *Bombyx mori* L., with comparative performance of shelf rearing vs shoot rearing in Khammam district, India

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Abstract

Season, region and silkworm variety specific studies of silkworm Bombyxmori L. are of greater importance in identifying and understanding the adaptability of silkworm genotypes which largely influenced by climatic factors. The present experiment was made to analyze seasonal performance with a comparison shelf verses shoot rearing of bivoltine hybrid varieties viz. (single breed CSR2XCSR4, and double breed CSR6xCSR26XCSR2xCSR27) of Bombyx mori L. to check their adaptability and rearing performance in the climatic conditions of Khammam district. The result shows that the overall performance in three seasons' i.e. rainy (Aug-Sep), winter (Nov-Dec) and summer (Feb-Mar), double breed shows better adaptation in Khammam district and in rearing Shoot rearing method shows better result in comparison to shelf method of rearing.

Keywords: Silkworms, Bombyxmori, bivoltine, genotypes, shelf rearing, shoot rearing, climatic conditions.

Introduction

Contemporary textiles are network of natural and/or artificial fibers, often termed as yarn or thread. Many fibers like cotton, silk, wool, and flax can be woven into flexible textiles. Silk is perhaps the finest of the other yarns available to produce elegant clothing. Silk is regarded as "Queen of Textiles" due to its characteristic light weight, soft touch, natural sheen, and affinity for dyes. Rearing of silkworms for the production of silk, sericulture practice, is an agro based industry that benefits the rural poor. Because of low capital, the influence of silk farming is substantial on economic status of the many parts of the Indian subcontinent. In the world, India is the second largest producer of silk after China. Gigantic part of the world's economically important protein fiber silk is produced by the domesticated silk moth *Bombyx mori L*. Therefore, we studied the effect of seasonal fluctuations, rearing methodology, and breeding type on the silk production in Khammam district of Telangana, India.

Aim: Silk production in India has been gaining its importance since its inception. Contemporary knowledge and technology allows the farmers to produce economically viable, and high quality silk to meet its demand. Climatic conditions, hybrid variety, and rearing type influence the quality and quantity of the silk. Present study is aimed to see the silkworm variety response to Khammam climatic conditions.

Materials and methods

In order to produce silk, silkworm has to be cultivated in suitable season or climate, and the silk yield differs if the choice of rearing method varies. The method of rearing involves the feeding of mulberry leaves to larvae, and disease management. In addition, frequency of breeding is another invincible choice, however the Khammam district climatic conditions suitable for bivoltine varieties. Further, hybrids definitely play a key role in silk quality and quantity; therefore, the whole methodology involves comprehensive consideration of above facts

Experimental material: The silkworm variety: The environmental conditions of the Khammam district is like any other south Indian Territory that possess to have specific climatic conditions. The popular south Indian bivoltine silkworm variety *Bombyx mori* was selected as experimental material to assess the virtual yield of the silk since it is common option in the Khammam district; thus, this investigation pays attention on this species. The breeds considered in the study are single breed (CSR2xCSR4) and double breed (CSR6xCSR26) x (CSR2xCSR27) of *B. mori* obtained from silkworm seed centre (CSB), Vijayawada, Andhra Pradesh, and all the established parameters that are supporting this study are measured for 6-10 larvae.

Seasonal choice during cultivation: In the present study, three seasons: Aug – Sep (temperature 27+1°C and relative humidity 70+5%), Nov–Dec (temperature 28 +1°C and relative humidity 65+5%), and Feb – Mar (temperature 30+1°C and relative humidity 65 + 5%) were considered to evaluate the influence of the seasonal fluctuations. The Indian mulberry Victoria-1 (V1), *Morus indica L*. used for silkworm feeding belong to the family Moraceae.

Rearing Material: The experimental procedure requires the following material: rearing house, sprayer, dry and wet thermos

meter, formalin, foam rubber strips, chop sticks, hygrometer, rearing stand with trays, cleaning nets, paraffin paper, feeding stand, cocoon character evaluator, cooking vessel, electronic digital weighing balance, denier scale, reeling machine, spectrophotometer.

Rearing House: Government Degree College rearing unit, Bhadrachalam was used for the cultivation of silkworms for the experiment. The coordinates of the Bhadrachalam are 17.67°N 80.88°E, and it has an average elevation of 50 meters from the sea level.

Silkworm Rearing Method: The silkworm eggs were obtained from the silkworm seed center of CSB at Vijayawada, Andhra Pradesh and hatched in incubator after maintaining necessary conditions temperature (25°C) and humidity (75%) to allow uniform and adequate number of hatchings. The setup was transferred to shelf rearing and shoot rearing arrangements which is one of the objectives of the study to investigate whether shoot rearing is effective in the Khammam climatic conditions. The young age worms, I – III Instars, and late age worms, IV and V Instars, are reared differently. The newly hatched young silkworms are fed with young leaves of mulberry using chawki rearing method.

Study parameter recording methods: The objective of the study is to state the seasonal influence on either double breed or single breed of silk worm variety with respect to shelf rearing and shoot rearing in the Khammam district climatic conditions. To support the study, in the present study as many as 12 different parameters were recorded quantitatively to establish the relation of seasonal impact on breeding type and rearing methodology.

All the parameters were recorded for the in three seasons during Aug – Sep (27+1°C, RH 70+5%), Nov – Dec (28+1°C, RH 65 + 5 %), and Feb – Mar (30 +1°C, RH 65+5%) from the year 2013 to 2015. and called these seasons as Crop-I, Crop-II, and Crop-III respectively. The parameters were observed in all the three seasons for both single breed and double breed silk worm varieties in shelf rearing and shoot rearing methods in three different Crops (seasons): Crop - I (monsoon: Aug-Sep); Crop - II (winter: Nov-Dec); and Crop – III (summer: Feb-Mar). Each value is the representation of 10 observations and 6 replications.

Estimation of hatching percentage: Hatching percentage is calculated using the following formula.

$$\text{Hatching percentage} = \frac{\text{Number of hatched eggs}}{\text{Total number of eggs}} \text{x } 100$$

Estimation of silk worm length: Instar wise length of the silkworm was measured after every Moulting in centimeter scale.

Estimation of silk worm weight: Instar wise weight of the silkworm was measured after every Moulting in grams on digital electronic weighing balance.

Estimation of Larval duration: Measured in hours from the day one of larval form to subsequent cocoon stage.

Estimation of Moulting duration: The Moulting duration in hours was recorded in all the larval stages in different Crops and rearing methods such as shelf rearing and shoot rearing in both single and double breed varieties.

Estimation of survival rate (%): Using the following formula:

$$\text{Survival Rate \%} = \frac{\text{Surviving in starsin the V Stage}}{\text{Total number of larva ehatched}} \text{x } 100$$

Estimation of cocoon yield: In the present study, 10,000 larva converted to cocoon was estimated as cocoon yield using the weight in kilograms.

Estimation of cocoon weight: in the present study, the cocoon weight is estimated in grams on digital electronic balance.

Estimation of shell weight: The shell weight is measured on electronic balance in grams.

Shell weight in grams= Cocoon weight in grams – Pupal weight in grams

Estimation of Shell to cocoon ratio: The shell to cocoon ratio is measured in the percentage using the following formula:

$$\text{Shell \%} = \frac{\text{Single shell weight in grams}}{\text{Single cocoon weight in grams}} \text{x } 100$$

Estimation of Renditta: Is calculated using the following formula

$$\text{Renditta (Kg)} = \text{number of coocoons used for 1 Kg silk}$$

Estimation of ERR%: ERR is calculated using the following formula.

$$\text{Effective rate of rearing} = \frac{\text{Number of larva espinning cocoon}}{\text{Number of larvaebr ushed}} \text{x } 100$$

Results and discussion

In the course of regional and climatic influence on sericulture a series of parameters had been studied including silk worm hatching rate, length, weight, larval duration, Moulting duration, survival rate, cocoon yield, cocoon weight, shell weight, shell to cocoon ratio, renditta, ERR%. The parameters that were validated in this study are being quantitative variables; they can adequately explain the seasonal role on the silkworm growth and silk yield thus adopted to validate them in this study.

Table-1: Estimation of hatching.

Year	Crop	Single vs double Breed			
		Difference		Percentage	
		Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	3.58	3.58	4.00	4.00
	Crop - II	3.64	3.64	4.10	4.10
	Crop - III	3.67	3.67	4.09	4.09
2014-2015	Crop - I	2.15	2.15	2.35	2.35
	Crop - II	3.50	3.50	3.93	3.93
	Crop - III	3.31	3.31	3.67	3.67
Mean		3.31	3.31	3.69	3.69

Table-2: Estimation of silk worm length.

Year	Crop		Single Vs Double Breed			
			Difference		Percentage	
			Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	III Instar	0.1	0.2	4.35	8.33
		IV Instar	0.1	0.1	2.86	2.70
		V Instar	0.2	0.1	3.03	1.39
	Crop - II	III Instar	0.1	0.2	4.55	8.70
		IV Instar	0.1	0.1	2.94	2.78
		V Instar	0.2	0.1	3.08	1.43
	Crop - III	III Instar	0.1	0.1	4.35	4.00
		IV Instar	0.1	0.1	2.94	2.78
		V Instar	0.2	0.4	3.08	5.88
2014-2015	Crop - I	III Instar	0.1	0.1	4.00	3.85
		IV Instar	0.2	0.1	5.88	2.63
		V Instar	0.3	0.4	4.55	5.80
	Crop - II	III Instar	0.2	0.2	8.70	8.33
		IV Instar	0.1	0.2	2.86	5.56
		V Instar	0.1	0.4	1.52	5.88
	Crop - III	III Instar	0.1	0.1	3.85	3.57
		IV Instar	0.1	0.3	2.86	8.33
		V Instar	0.2	0.3	3.03	4.35
Mean			0.14	.19	3.8	4.79

Table-3: Estimation of silk worm weight (grams).

Year	Crop		Single Vs Double Breed			
			Difference		Percentage	
			Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	III Instar	0.4	0.3	4.88	3.49
		IV Instar	0.9	1	4.95	5.21
		V Instar	1	1.1	2.55	2.66
		IV Instar	1	1.7	5.62	9.29
		V Instar	0.7	2	1.84	5.10
	Crop -III	III Instar	0.3	0.1	3.70	1.15
		IV Instar	1.5	1.4	8.29	7.14
		V Instar	1.1	0.7	2.77	1.69
2014-2015	Crop -I	III Instar	0.1	0.15	1.20	1.70
		IV Instar	1.08	1.4	5.81	7.07
		V Instar	0.9	1	2.28	2.41
	Crop -II	III Instar	0.3	0.3	3.80	3.57
		IV Instar	0.5	1.5	2.84	8.20
		V Instar	0.5	1.1	1.33	2.86
	Crop -III	III Instar	0.3	0.1	3.66	1.14
		IV Instar	1.3	1.6	7.07	8.16
		V Instar	1.1	0.8	2.76	1.93
Mean			0.76	0.96	3.84	4.28

Table-4: Estimation of survival rate.

Year	Crop	Single Vs Double Breed			
		Difference		Percentage	
		Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	0.8	0.9	0.9	1.0
	Crop - II	0.5	0.8	0.5	0.9
	Crop - III	0.5	0.9	0.5	1.0
2014-2015	Crop - I	0.8	1.0	0.9	1.1
	Crop - II	0.6	0.5	0.7	0.5
	Crop - III	0.8	0.5	0.9	0.5
Mean		0.67	0.77	0.73	0.83

Table-5: Estimation of Larval duration (Hrs).

Year	Crop		Single Vs Double Breed			
			Difference		Percentage	
			Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	I Instar	0	0	0	0
		II Instar	0	0	0	0
		III Instar	0	-12	0	-13
		IV Instar	-12	0	-11	0
		V Instar	-12	0	-7	0
	Crop - II	I Instar	0	0	0	0
		II Instar	0	0	0	0
		III Instar	0	0	0	0
		IV Instar	-6	-6	-6	-6
		V Instar	-12	-12	-7	-7
	Crop - III	I Instar	-12	-12	-17	-17
		II Instar	0	0	0	0
		III Instar	-12	-12	-14	-14
		IV Instar	0	0	0	0
		V Instar	-12	-12	-7	-7
2014-2015	Crop - I	I Instar	0	0	0	0
		II Instar	0	0	0	0
		III Instar	0	0	0	0
		IV Instar	0	0	0	0
		V Instar	0	0	0	0
	Crop - II	I Instar	0	0	0	0
		II Instar	-12	-12	-17	-17
		III Instar	-6	0	-8	0
		IV Instar	0	6	0	7
		V Instar	-12	0	-8	0
	Crop - III	I Instar	0	0	0	0
		II Instar	-6	-6	-10	-11
		III Instar	0	0	0	0
		IV Instar	0	0	0	0
		V Instar	0	0	0	0
Mean			-3.8	-2.6	-3.73	-2.83

Table-6: Estimation of survival rate.

Year	Crop	Single Vs Double Breed			
		Difference		Percentage	
		Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	0.8	0.9	0.9	1.0
	Crop - II	0.5	0.8	0.5	0.9
	Crop - III	0.5	0.9	0.5	1.0
2014-2015	Crop - I	0.8	1.0	0.9	1.1
	Crop - II	0.6	0.5	0.7	0.5
	Crop - III	0.8	0.5	0.9	0.5
Mean		0.67	0.77	0.73	0.83

Table-7: Estimation of Moulting duration (hrs).

Year	Crop		Single Vs Double Breed			
			Difference		Percentage	
			Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	I Moult	-1	0	-5	0
		II Moult	-1	-1	-5	-5
		III Moult	-1	-1	-4	-5
		IV Moult	-1	-1	-4	-4
	Crop -II	I Moult	-1	-1	-5	-5
		II Moult	-1	-1	-5	-5
		III Moult	0	0	0	0
		IV Moult	0	-1	0	-4
	Crop - III	I Moult	0	0	0	0
		II Moult	0	-1	0	-5
		III Moult	-1	-1	-4	-5
		IV Moult	-1	-1	-4	-4
2014-2015	Crop - I	I Moult	0	-1	0	-5
		II Moult	-1	-1	-5	-5
		III Moult	0	0	0	0
		IV Moult	-1	-1	-4	-4
	Crop - II	I Moult	-1	-1	-5	-5
		II Moult	-1	-1	-5	-5
		III Moult	0	-1	0	-4
		IV Moult	-1	-1	-4	-4
	Crop - III	I Moult	-1	0	-5	0
		II Moult	-1	0	-5	0
		III Moult	-1	-1	-4	-4
		IV Moult	0	0	0	0
Mean			-0.67	-0.71	-3.04	-3.25

Table-8: Estimation of cocoon yield: 10,000 larvae (KG).

Year	Crop	Single Vs Double Breed			
		Difference		Percentage	
		Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	0.07	0.19	0.39	1.04
	Crop - II	0.16	0.20	0.89	1.10
	Crop - III	0.02	0.20	0.11	1.10
2014-2015	Crop - I	0.04	0.24	0.22	1.32
	Crop - II	0.05	0.21	0.28	1.15
	Crop - III	0.07	0.23	0.39	1.27
Mean		0.07	0.21	0.38	1.16

Table-9: Estimation of cocoon weight.

Year	Crop	Single Vs Double Breed			
		Difference		Percentage	
		Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	0.017	0.068	0.943	3.692
	Crop - II	0.048	0.063	2.691	3.446
	Crop - III	0.032	0.071	1.782	3.901
2014-2015	Crop - I	0.816	0.074	80.000	4.017
	Crop - II	0.035	0.069	1.952	3.779
	Crop - III	0.044	0.078	2.449	4.244
Mean		0.165	0.071	14.97	3.847

Table-10: Estimation of shell weight.

Year	Crop	Single Vs Double Breed			
		Difference		Percentage	
		Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	Crop - I	0.027	0.024	7.418	6.030
	Crop - II	0.042	0.024	12.281	6.091
	Crop - III	0.021	0.014	5.512	3.382
2014-2015	Crop - I	0.012	0.016	3.061	3.855
	Crop - II	0.015	0.022	3.989	5.446
	Crop - III	0.004	0.013	1.010	3.103
Mean		0.02	0.019	5.545	4.651

Table-11: Estimation of Shell to cocoon ratio.

Year	Crop	Single Vs Double Breed			
		Difference		Percentage	
		Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	CROP - I	0.3	1.0	1.4	4.4
	CROP-II	0.8	0.4	3.7	1.8
	CROP -III	0.2	0.6	0.9	2.6
2014-2015	CROP -I	0.4	0.8	1.8	3.5
	CROP-II	0.6	0.3	2.8	1.3
	CROP -III	0.3	0.8	1.3	3.5
Mean		0.43	0.65	1.98	2.85

Table-12: Estimation of Renditta.

Year	Crop	Single Vs Double Breed			
		Difference		Percentage	
		Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	CROP - I	-0.11	-0.39	-1.91	-6.83
	CROP-II	-0.09	-0.31	-1.56	-5.40
	CROP -III	-0.18	-0.41	-3.13	-7.21
2014-2015	CROP -I	-0.30	-0.36	-5.16	-6.29
	CROP-II	-0.16	-0.31	-2.74	-5.46
	CROP -III	-0.17	-0.28	-2.98	-4.98
Mean		-0.17	-0.34	-2.91	-6.03

Table-13: Estimation of ERR%.

Year	Crop	Single Vs Double Breed			
		Difference		Percentage	
		Shelf Rearing System	Shoot Rearing System	Shelf Rearing System	Shoot Rearing System
2013-2014	CROP - I	0.60	4.40	0.71	5.15
	CROP-II	1.10	3.40	1.32	3.99
	CROP -III	0.20	3.80	0.23	4.40
2014-2015	CROP -I	0.40	3.20	0.47	3.71
	CROP-II	1.00	2.70	1.19	3.15
	CROP -III	0.80	3.10	0.94	3.56
Mean		0.68	3.43	0.81	3.99

Discussion: Silk forming is the age old agricultural practice since Neolithic period in the India, and it imparts in the rural economic growth. As much as 60% of the world silk is produced from China and India. As per the records of central silk board of India, 12 states: Andhra Pradesh, Assam, Bihar, Gujarat, Jammu & Kashmir, Karnataka, Chhattisgarh, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal are producing the silk. Being India is a subcontinent, there are wide range of geographical zones and climatic conditions exist across the India. Adopting a right breed and rearing method is critical factor in a given climatic condition. In this study, Impact of Khammam district climatic condition including monsoon, winter, and summer seasons was estimated on single breed (CSR2 X CSR4) and double breed ((CSR2 X CSR27) X (CSR6 X CSR26)) of the *Bombyx mori* L. In order to demonstrate the seasonal fluctuation role on silkworm was studied using following parameters: hatching percentage, length, weight, larval duration, Moulting duration, survival rate, cocoon yield, cocoon weight, shell weight, shell to cocoon ratio, ERR%. These findings suggests different factors facilitating variable response with respect to breeding type and rearing method in Khammam district, Telangana climatic conditions.

The hatching percentage of single breed was 90% while double breed reported 93% in the *Bombyx mori*. After hatching, the larva stage is being emerged out from the egg and it undergoes series of Moultings by forming V Instars at least, which are morphologically distinct from each other by length, weight, and size. The length of the silkworm was measured in Instar III, IV, and V, where Instar V length is larger. Our results reveals that there is no role of rearing method in the Instar length however double breed found to be much better than the single breed. Single breed incremented insignificantly across the three seasons but double breed increased 73% more in the Crop-III, summer. It seems that high temperature is more suitable for the Khammam conditions. Interestingly, the weight of the Instar is more or less similar across the seasons except in winter (Crop II) though length appears to be changed with seasonal impact. The single breed Instar of the winter (Crop II) exhibited 20% less weight than the normal weight even though rearing method does not show any impact. A quantitative profile of single breed *Bombyx mori* L. (CSR2XCSR4), a different cross from this study (CSR2 X CSR27), study arguably reported maximum weight of 2g[1], on the other hand CSR2 X CSR27 reproduced as much as 22.6g. The growth in length and weight stems from the mulberry leaf consumption, and it was observed from the results single breed variety consumed 1.5% higher than the double breed. The larval duration was fluctuated across the seasons and winter season has showed 4.7% lesser larval duration than monsoon and summer. While rearing method does not affect the larval duration, the double breed manifested less larval duration than the single breed variety of the silkworm. The average larval duration observed in this study was indisputable with reported results; however, they studied the influence of the different variety of the mulberry leaves[2]; and conversely, this study focused on the seasonal fluctuation impact on the larval duration. The Moulting is the typical phenomenon observed in insects and silkworm larval stage undergoes four Moultings and average Moulting duration is 21hr. However, seasonal influence was not observed on Moulting duration but single breed and shelf rearing method showed little higher duration. In the reported study it was observed the impact of the nutrition composition on the Moulting duration[3] but not the seasonal influence, breeding variety, and rearing method. This study validated the paucity in the established methods related to breeding variety and seasonal impact.

After measuring growth parameters of the silkworm, survival rate and next morphological stage, cocoon, characteristics were studied. The survival rate of the double breed was found to be higher than the single breed, but rearing method and seasonal influence did not show impact on the survival rate. The average survival rate was found to be 90.2% and it is similar to the reported results reported elsewhere though they studied about the thermo tolerance[4]. The cocoon yield of 10,000 cocoons were estimated and the average cocoon yield was found to be 16.9kg though double breed showed 14.6% higher yield. These findings confirmed the reported average value 17.0kg however the report was generated from the single breed variety CS6xPam 101 of *Bombyx mori*[5]. The cocoon yield was remain unchanged in the rearing methods adopted and the seasonal shifts. The cocoon weight was measured and found 3% increase in the double breed and shoot rearing system and the result substantiated the reported result[6]. The average shell weight was found to be 0.4g and these results are in agreement with the reported results[7]. Interestingly, shoot rearing system and double breed produced higher shell weight and it is the desired outcome from this study as higher shell weight anticipated to produce more silk. As anticipated, the double breed variety and shoot rearing system rendered about 2.5% more shell weight regardless of seasonal changes. The average shell weight observed in the breeding varieties found to 22.7% out of total cocoon weight and our results are in compliance with the established results[8]. The overall cocoon characteristics are found to be efficient in the double breeding variety of silk moth *Bombyx mori* L (CSR2 X CSR27) X (CSR6 X CSR26).

The renditta in this study was found to be 5.61 kg but in the reports it was found to be 5.5kg, though the study was focused on the impact of novel bio foliar[9]. The renditta was found to be better in double breeding variety and shoot rearing system regardless of the seasonal influence. The ERR% was found to be 86.31% and in reports it was noted that 18-65% in the muga silkworm, while direct and chawki methods reported 21.9% and 49.1% in the tasar silkworm[10]. The ERR% was found to be better in the double breeding variety of silkworm and shoot rearing method; however, seasonal changes did not show any effect on the ERR% change. This study unveiled the seasonal response; monsoon, winter, and summer; on the two bivoltine, single (CSR2 X CSR4) and double breed ((CSR2 X CSR27) X (CSR6 X CSR26)), varieties of the *Bombyx mori* L while using shelf rearing and shoot rearing systems as culturing methods in

the Khammam district, Telangana. The comparative analysis after observing 12 different parameters comprehensively which explain the hatching rate, larval characteristics, cocoon and shell characteristics. The results confirmed that double breed variety was found to be efficient than the single breed variety, while shoot rearing system has the high silk producing capacity than the shelf rearing system in the all the 12 observations. Although this study is extensive and comprehensive, the maintenance of the rearing house and care taken during the study likely to impair the results certain extent. However, these findings explained the anticipated result of double breed variety and shoot rearing system better than the single breed variety and shelf rearing system regardless of the seasonal changes in the Khammam climatic conditions.

Conclusion

In summary, our study unveiled that there was no effect of seasonal changes on the single and double breed varieties of the *Bombyx mori* L, a widely used silk producing variety in the Indian subcontinent. For the higher production, this study confirmed the shoot rearing method is a viable option if compared with the shelf rearing system. Though the double breed variety of the silkworm outperformed in the Khammam region regardless of the seasonal fluctuations, the method has the scope to adopt in similar climatic conditions in the other geographical locations.

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