Biological Forum – An International Journal **14(2): 1140-1145(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Role of Biotic and Abiotic Factors Influencing Cocoon Productivity in Jammu Region

Ravi Kant[1*], K. Bali[2], R. K. Gupta[2], R. Sharma[3], S. Sharma[4] and P. Singh[4]
[1]Research Scholar, Division of Sericulture, FoA, SKUAST-J (J&K), India.
[2]Division of Sericulture, FoA, SKUAST-J (J&K), India.
[3]Associate Professor, Division of Agricultural Extension Education, FoA, SKUAST-J (J&K), India.
[4]Assistant Professor, GDC, Samba (J&K), India.
[5]Assistant Professor, ACRA, Dhiansar, SKUAST-J (J&K), India.

(Corresponding author: Ravi Kant)*
(Received 29 March 2022, Accepted 27 May, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The UT of J&K has two distinct sericultural zones viz., temperate and sub-tropical based on agro-climatic conditions. It is a bivoltine sericulture region having only two crops per year but its silk has outstanding quality on international level. Success of sericulture industry mainly relays on quality mulberry leaves, climatic factors, quality of silkworm seed, rearing technologies and other factors. Data on abiotic factors namely temperature, humidity, rainfall and cocoon yield and biotic factor namely disease incidence percentage (Grasserie & Flacherie) of the 225 respondents under study was recorded during spring and autumn rearing season (2019 & 2020) in three districts *viz*., Ramban, Doda and Kishtwar of Jammu division. The main challenge of the present study was to identify various biotic and abiotic factors hindering the potential bivoltine cocoon yield. Analysis of data using Pearson's correlation coefficient revealed that in autumn season, climatic factors namely temperature and humidity were highly correlated to grasserie incidence and impacting overall cocoon yield. Incidence of flacherie was uneven but significant. Factor rainfall was significant and positively correlated to grasserie incidence in autumn season. Temperature was recorded positive and significant while the impact of rainfall and humidity was non-significant with cocoon yield during spring.

Keywords: Climatic factors**,** Disease incidence, Cocoon yield.

INTRODUCTION

Sericulture is the science that deals with the production of silk by rearing of silkworm. Silk is called the queen of textiles due to its glittering luster, softness, elegance, durability, and tensile properties and originating in the spittle of an insect is a natural fibrous substance and is obtained from pupal nests or cocoons spun by larvae known as silkworm. The silk is preferred over all other types of fibers due to its remarkable properties like water absorbency, heat resistance, dyeing efficiency, and luster. Factors mainly influence the physiology of insects are temperature and humidity. Despite wide fluctuations in their surroundings, insects show a remarkable range of adaptations to fluctuating environmental conditions and maintain their internal temperature and water content within tolerable limits (Rahmathulla, 2012).

The mulberry silkworm (*Bombyx mori* L.) is very delicate, highly sensitive to environmental fluctuations, and unable to survive extreme natural fluctuation in temperature and humidity because of their long years of domestication .Thus, the adaptability to environmental conditions in the silkworm is quite different from those of wild silkworm and other insects. Temperature, humidity, air circulation, gases and light show a significant interaction in their effect on the physiology of silkworm depending upon the combination of factors and developmental stages affecting growth, development, productivity, and quality of silk. It is a well-established fact that under tropical condition, unlike polyvoltines, bivoltines are more vulnerable to various stresses like hot climatic conditions of tropics, poor leaf quality, and improper management of silkworm crop during summer that is not conducive for bivoltine rearing for technologically and economically poor farmers of India (Kumar *et al*., 2001; Lakshmi and Chandrashekaraiah, 2007 and Begum *et al.*, 2008).

The biological as well as cocoon-related characters are influenced by ambient temperature, rearing seasons, quality mulberry leaf, and genetic constitution of silkworm strains. Different seasons affect the performance of *Bombyx mori* L. The seasonal differences in the environmental components considerably affect the genotypic expression in the form of phenotypic output such as cocoon weight, shell weight, color, elasticity and shell ratio. The variations in the environmental conditions emphasize the need of management of the temperature and relative humidity for sustainable cocoon production (Rahmathulla, 2012).

The fluctuation of mid-day temperature and Relative Humidity revealed that the temperature under all the grainage system was similar to natural conditions. Whereas, Relative Humidity under pucca grainage house and green shade net structure was similar to natural conditions, in which Relative Humidity equal or higher than the temperature with lowest fluctuation rate and finally it was suggested that the shade net grainage house followed by pucca grainage house are the best in terms of maintenance of optimum temperature and relative humidity under grainage house suitable for tasar silkworm cocoons (Rathore *et al.* 2018).

Three feedings per day was statistically at par with the four feedings in terms of various parameters including larval survival percentage, larval weight, cocoon yield by wt. and by no., single cocoon weight, single shell weight and shell ratio percentage. However total filament lengths, non-breakable filament length and filament size varied significantly (Raghuvanshi *et al.* 2019).

The powerful absorption of food given to silkworms relies upon at the floor of the region on which they're placed. Because the feeding vicinity decreases the worms become thicker and smaller and as a end result the worms start to develop larger and smaller without being able to devour frivolously and a lower in feeding region and quantity of feed given to worm at some stage in feeding duration additionally ends in lower in overall range of cocoons (Rakhmanova, 2020).

MATERIALS AND METHODS

The sample of the study was initially based on multistage sampling technique. Data from random sample of 225 respondents was computed for analysis from threedistricts namely Ramban, Doda and Kishtwar in Jammu regionduring spring and autumn rearing seasons (2019 and2020). Double hybrid silkworm seed FC1×FC2 procured from Central Silk Board (CSB), Bangalore were distributed to the respondents after 2nd moult (*i.e.* chawki reared worms) from respective district sericulture development department. Wet and dry thermometer was used for recording temperature and humidity in the respondents rearing houses. Diseased larvae depicting different microbial symptoms were collected and Pearson correlation analysis was used to measure the degree of association between variables namely temperature, humidity, silkworm diseases (Grasserie & Flacherie) incidence and cocoon yield.

RESULTS AND DISCUSSION

The pooled correlation coefficient (r) value between temperature, humidity, rainfall, incidence of silkworm diseases and cocoon yield in district Kishtwar during spring (March-April) and autumn (August-September) rearing season (2019 & 2020) is presented in Table 1. It was observed that with respect to the incidence of grasserie during autumn season among the various abiotic factors, temperature was highly significant and positively correlated factor (r=0.57) followed by humidity (r = 0.43) which was significant and positively correlated and rainfall (r = -0.04) was non-significant and negatively correlated. In case of incidence of flacherrie, temperature was positively correlated but non-significant (r = 0.04 & 0.06) during spring rearing with a pooled r =0.05 and during autumn season (r = 0.15 & 0.13) with pooled r-value of 0.14. Cocoon yield was positively correlated to temperature (r=0.11 & 0.09) with a pooled r value of 0.10 and non-significant during spring season but significant and negatively correlated (r = -0.34 & -0.32) with a pooled r value of -0.33 during autumn rearing season. Humidity was positively correlated and non-significant to the incidence of grasserie (r = 0.11 & 0.17) with a pooled r-value of 0.14 during spring season and was found positive and significantly correlated (r = 0.52 & 0.34) during autumn season (pooled r = 0.43). Incidence of flacherie was negatively correlated and non significant during both seasons with pooled r-value in spring season (-0.06) and autumn season (-0.03). Cocoon yield was significant but negatively correlated to humidity during autumn season (r = -0.32) and non significant in spring rearing (r = -0.11). Rainfall was non-significant and positively correlated to incidence of grasserie during spring season (r=0.01) and non-significant and negatively correlated during autumn season (r = -0.04). Flacherie was also recorded non-significant and positively correlated to rainfall during spring season (r = 0.04) and significant and negatively correlated during autumn season (r = -0.23). Rainfall was found negatively correlated but non-significant to cocoon yield during spring season having pooled r value of -0.05 and positively correlated but non-significant in autumn season with pooled r = 0.09.

Table 1: Correlation between biotic and abiotic factors in district Kishtwar.

Sr. No.	Environmental factors		Disease incidence					
			Grasserie		Flacherrie		Cocoon yield	
1	Temperature	Year	Seasons					
			Spring	Autumn	Spring	Autumn	Spring	Autumn
		2019	0.09	0.49*	0.04	0.15	0.11	-0.34*
		2020	0.15	0.65**	0.06	0.13	0.09	-0.32*
		Pooled	0.12	0.57**	0.05	0.14	0.10	-0.33*
2	Humidity	2019	0.11	0.52**	-0.05	-0.04	-0.06	-0.39*
		2020	0.17	0.34*	-0.01	-0.02	-0.16	-0.25*
		Pooled	0.14	0.43*	-0.06	-0.03	-0.11	-0.32*
3	Rainfall	2019	0.00	-0.03	0.05	-0.31*	-0.03	0.12
		2020	0.02	-0.05	0.03	-0.15	-0.07	0.06
		Pooled	0.01	-0.04	0.04	-0.23*	-0.05	0.09

* significant at 0.05% and ** highly significant at 0.1%

The pooled correlation coefficient (r) value between temperature, humidity, rainfall, incidence of silkworm disease namelygrasserie & flacherie and cocoon yield in district Ramban during spring and autumn rearing season (2019 & 2020) is shown in Table 2. It was observed that with respect to the incidence of grasserie during autumn season, abiotic factor humidity was correlated factor (pooled r = 0.61) and highly significant followed by temperature (r = 0.49) which was significant and positively correlated and rainfall (r = -0.17) was non-significant and negatively correlated. In case of incidence of flacherrie, temperature was positively correlated but non-significant (r = 0.02 & 0.04) during spring rearing with a pooled value of r = 0.03 and during autumn season (r = -0.15 & -0.03) with pooled r value of -0.09 was recorded. Cocoon yield was positively correlated to temperature (r = 0.06 & 0.22) with a pooled r value 0.14 and non-significant during spring season but significant and negatively correlated (r = -0.40 & -0.36) with a pooled r value of -0.38 during autumn rearing season. Humidity was positively correlated and non-significant to the incidence of grasserie (r = 0.12 & 0.08) with a pooled r-value of 0.10 during spring season and was positive and significantly correlated (r = 0.75 & 0.47) during autumn season (pooled r = 0.61). Incidence of flacherie was negatively correlated and non significant with pooled r-value in spring season (-0.05) and significant in autumn season (-0.25). Cocoon yield was negatively and significantly correlated to humidity during autumn season (r = -0.22) and non-significant in spring rearing (r = 0.11). Rainfall was found to be non-significant and positively correlated to incidence of grasserie during spring season (r = 0.03) and non significant and negatively correlated during autumn season (r = -0.17). Flacherie was also found be non-significant and positively correlated to rainfall during spring season (r = 0.02) and non-significant and negatively correlated during autumn season (r = -0.06). Rainfall was found negatively correlated but non-significant to cocoon yield during spring season (pooled r = -0.07) and negatively correlated but non-significant in autumn season (pooled r = -0.10).

Table 2: Correlation between biotic and abiotic factors in district Ramban.

Sr. No.	Environmental factors		Disease incidence					
			Grasserie		Flacherie		Cocoon yield	
1	Temperature	Year			Seasons			
			Spring	Autumn	Spring	Autumn	Spring	Autumn
		2019	0.15	0.44*	0.02	-0.15	0.06	-0.40*
		2020	0.11	0.54**	0.04	0.03	0.22*	-0.36*
		Pooled	0.13	0.49*	0.03	-0.09	0.14	-0.38*
2	Humidity	2019	0.12	0.75**	-0.03	-0.23*	0.09	-0.19*
		2020	0.08	0.47*	-0.07	-0.27*	0.13	-0.25*
		Pooled	0.10	0.61**	-0.05	-0.25*	-0.11	-0.22*
3	Rainfall	2019	0.01	-0.13	0.03	-0.03	0.10	-0.09
		2020	0.05	-0.21*	0.01	-0.09	0.04	-0.11
		Pooled	-0.03	-0.17	0.02	- 0.06	0.07	-0.10

* significant at 0.05% and ** highly significant at 0.1%

The pooled correlation coefficient (r) value between temperature, humidity, rainfall, incidence of grasserie & flacherie and cocoon yield in district Ramban during spring and autumn rearing season (2019 & 2020) is presented in Table 3. It was observed that with respect to the incidence of grasserie during autumn season among the various abiotic factors temperature was highly significant and correlated factor (pooled r=0.76)

followed by humidity (r = 0.59) which was significant and positively correlated and rainfall (r = -0.28) was significant and positively correlated. In case of incidence of flacherrie, temperature was positively correlated & non-significant (r = 0.12 & 0.04) during spring rearing with a pooled value of r = 0.08 and during autumn season temperature was found positively correlated but non-significant (r = 0.04 & 0.02) with pooled r value of 0.03 was recorded. Cocoon yield was positively correlated and non-significant with temperature (r = 0.10 & 0.22) with a pooled r value 0.16 during spring season but highly significant and negatively correlated (r = -0.51 & -0.55) with a pooled r value of -0.53 during autumn rearing season. Humidity was recorded positively correlated and significant to the incidence of grasserie (r = 0.19 & 0.15) with a pooled r-value of 0.17 during spring season and was positive and highly significant and correlated (r = 0.69 & 0.49) during autumn season (pooled r = 0.59). Incidence of flacherie was positively correlated and non significant with pooled r-value in spring season (0.09) and significant in autumn season (0.12). Cocoon yield was negative but significantly correlated to humidity during autumn season (r = -0.46) and negatively correlated and significant in spring rearing (r = -0.13). Rainfall was recorded non significant and negatively correlated to incidence of grasserie during spring season (r = -0.06) and significant and positively correlated during autumn season (r = -0.27). Flacherie was also observed non-significant and negatively correlated to rainfall during spring season (r = -0.04) and non-significant and positively correlated during autumn season (r = 0.07). Rainfall was positively correlated but non-significant to cocoon yield during spring season (pooled r = 0.08) and negatively correlated but non-significant in autumn season (pooled r = -0.03).

Table 3: Correlation between biotic and abiotic factors in district Doda.

Sr. No.	Environmental factors		Disease incidence					
			Grasserie		Flacherie		Cocoon yield	
1.	Temperature	Year	Seasons					
			Spring	Autumn	Spring	Autumn	Spring	Autumn
		2019	0.20*	0.70**	0.12	0.04	0.10	-0.51**
		2020	0.18*	0.82**	0.04	0.02	0.22*	-0.55**
		Pooled	0.19*	0.76**	0.08	0.03	0.16	-0.53**
2.	Humidity	2019	0.19*	0.69**	0.10*	0.16*	-0.15	-0.37*
		2020	0.15	0.49*	0.08	0.08	-0.11	-0.55*
		Pooled	0.17*	0.59**	0.09	0.12*	-0.13	-0.46*
3.	Rainfall	2019	-0.08	0.29*	-0.06	0.08	0.09	-0.02
		2020	-0.04	0.25*	-0.02	0.06	0.06	-0.04
		Pooled	-0.06	0.27*	-0.04	0.07	0.08	-0.03

* significant at 0.05% and ** highly significant at 0.1%

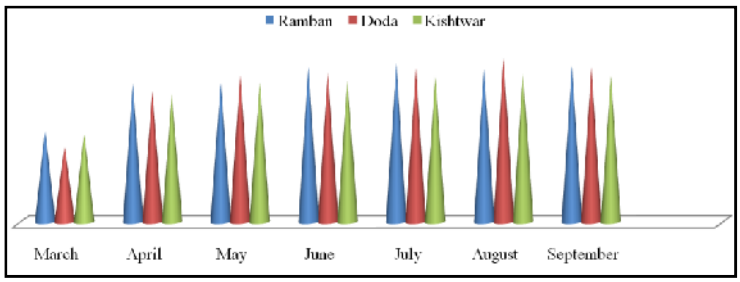

Fig. 1. Pooled temperature (°C) recorded in the rearing season (2019 & 2020).

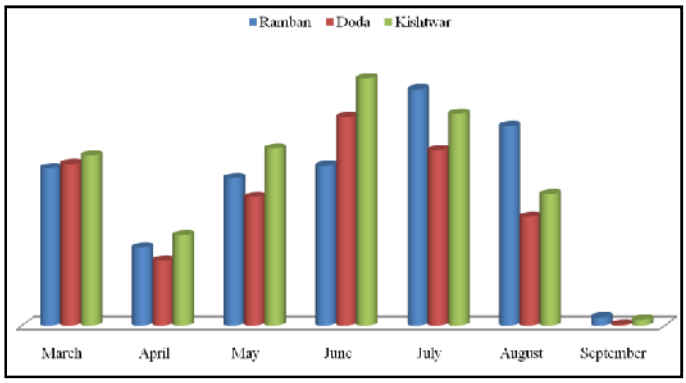

Fig. 2. Pooled average rainfall (mm) recorded in the rearing season (2019 & 2020).

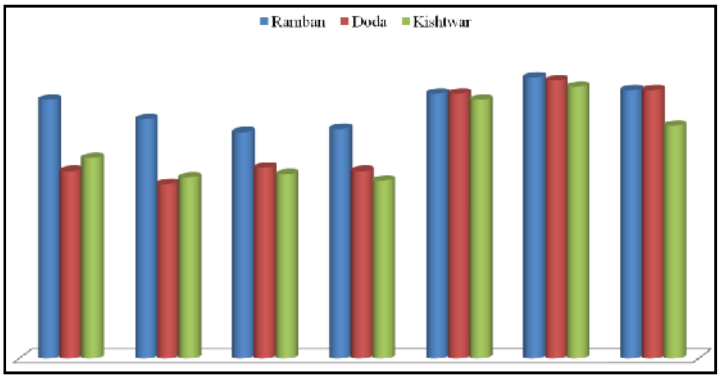

Fig. 3. Pooled humidity (%) recorded in the rearing season (2019 & 2020).

Environment impact on growth and development of *Bombyx mori* played a vital role in the improvement of silk industry. Silkworm rearing was solely based on environment conditions in general and seasonal variations were found to have immense influence on it especially bivoltine breed (Giridhar *et al.,* 1990) .Spring season is considered favourable for silkworm rearing when temperature is moderate and humidity is optimum. In the autumn season temperature and humidity remain high especially prevailing high humidity with intermediate rain resulting in fluctuation in temperature is the major factor responsible for crop loss by influencing growth of grasserie virus (Deb *et al*., 2015). The studies on prevalence of different silkworm diseases in temperate and subtropical zone of Jammu division of J&K UT in commercial seasons were analysed. Occurrence of various diseases in silkworm has direct relationship with various rearing conditions prevailing in rearing house especially irregularities in maintenance of micro climatic conditions and hygiene which led to outbreak of grasserie and flacherie diseases. In the present study, grasserie disease prevalence was significantly high in all the three districts particularly in autumn season. Maximum incidence of grasserie (23.56%) and flacherie (4.68%) was recorded during autumn season in District Doda. Present study confirms the high prevalence of nuclear polyhedrosis in Jammu division as reported by Illahi and Nataraju (2007); Singh *et al.* (2009); Balavenkatasubbaiah *et al.* (2014). The incidences of grasserie are related to high temperature and higher humidity due to overcrowding and unhygienic conditions in the rearing bed. Fluctuation in temperature during the rearing period disturbs the physiological conditions of silkworm and it makes them susceptible to flacherie disease. Poor quality leaf drastically influences the growth of larvae which makes them prone to bacterial flacherie. In the present study, non-significant data on incidence of flacherie disease was recorded. Average flacherie disease was recorded maximum in district Doda (2.61 %). Season wise average incidence of flacherie disease was more in autumn (1.72 %) as compared to spring. Majority of the rearers did not practice silkworm bed disinfection although disinfectant was provided and silkworms were reared in overcrowded conditions. The observations fall in line with Selvakumar *et al.* (2002).

CONCLUSION

The correlation coefficient values concluded that the high viral and bacterial infection was recorded in autumn season due to high temperature and humidity. Climatic factors are one of the important factors that influences disease incidence in silkworm. So adoption of recommended practices for effective crop protection during harsh conditions of autumn season can help the respondents to overcome the crop loss.

FUTURE SCOPE

The present study will help the extension workers and silkworm rearers how to deal with the various biotic and abiotic factors that hinders the growth in cocoon yield by adopting various recommended technologies at right time and right place which may reduce the cocoon loss.

Acknowledgement. Authors are thankful to the technical staffs of CSB (Central Silk Board), Miransahib, Jammu and DoS, SKUAST-Jammu for their continuous help and their co-operations and valuable suggestions during the study.

Conflict of Interest. The authors declare that there is no conflict of interest in the conduct of this experiment and publication of the findings.

REFERENCES

Balavenkatasubbaiah, M., Shivashankar, N., Maheswari, M., Mathur, V.B., Chandrasekharan, K. and Narasimha, N.A.R. (2014). Prevalence of Silkworm Diseases and their Impact on Cocoon Productivity in the Selected Areas of Karnataka, India. *Indian Journal of Sericulture*, *53*(2): 51-59.

Begum, N. A. R.., Basavaraja, H. K., Joge, P. G. and Palit, A. K. (2008). Evaluation and Identification of Promising Bivoltine Breeds in the Silkworm, *Bombyx mori* L. *International Journal of Industrial Entomology*, *16*(1): 15–20.

Deb, S., Chakraborty, S., Hazra, N., Saha, A.K. and Chakraborty, C. (2015). Impact of Temperature and Humidity on Incidence of Grasserie in Silkworm,

Bombyx mori L. in West Bengal. *Journal of Plant Protection and Environment, 12*(1): 19-26.

Giridhar, K., Lakshmanan, S., Benchamin, K.V. and Sengupta, K. (1990). Performance of Local and Kanva-2 Mulberry Varieties in respect of Leaf and Cocoon Yield at Farmers Level. *Indian Journal of Sericulture, 29*: 219-226.

Illahi I, Nataraju B. (2007). Prevalence of Nuclear Polyhedrosis in Mulberry Silkworm, *Bombyx mori* L. in Jammu and Kashmir. *Indian Journal of Sericulture*, *46*(1): 43-48.

Kumar, S.N., Yamamoto, T., Basavaraja, H. K. and Datta, R. K. (2001). Studies on the Effect of High Temperature on F1 hybrids between Polyvoltine and Bivoltine Silkworm races of *Bombyx mori* L. *International Journal of Industrial Entomology, 2*(2): 123–127.

Lakshmi, H. and Chandrashekaraiah, M. (2007). Identification of Breeding Research Material for the Development of Thermo-tolerant Breeds of Silkworm, *Bombyx mori* L. *Journal of Experimental Zoology India*, *10*(1): 55–63.

Raghuvanshi, T., Bali, R.K. and Bukhari, R. (2019). Effect of Different Feeding Frequencies on the Commercial Characters of Silkworm (*Bombyx mori.* L.). *International Journal Current Microbiology Applied Science*, *8*(6): 3193-3203.

Rahmathulla, V. K. (2012). Management of Climatic Factors for Successful Silkworm *(Bombyx mori* L.) Crop and Higher Silk production: A Review, *Psyche*, 1-12.

Rakhmanova, H.E. (2020). Influence of Silkworm Feeding Area and Nutrient Content on Cocoon Yield and Technological Properties. *International Journal of Science and Research*, *9*(3): 1514-1515.

Rathore, M.S., Chandrashekharaiah, M., Sinha, R.B., Sahay, A. (2018). Studies on Variation of Abiotic Factors in Different Grainage Houses of Tasar Silkworm (*Antheraea mylitta* D.) at Bilaspur. *International Journal of Research in Engineering, Science and Management, 1*(9): 198-200.

Singh, T., Bhat, M. M. and Khan, M. A. (2009). Insect Adaptations to Changing Environments-Temperature and Humidity. *International Journal of Industrial Entomology*, *19*(1): 155-164.

Selvakumar, T., Nataraju, B., Balavenkatasubbaiah, M., Sivaprasad, V. and Baig, M. (2002). A Report on The Prevalence of Silkworm Diseases and Estimated Crop loss. *Advances in Indian Sericulture Research*, CSRTI, Mysore, 357-357.

How to cite this article: Ravi Kant, K. Bali, R. K. Gupta, R. Sharma, S Sharma and P. Singh (2022). Role of Biotic and Abiotic Factors Influencing Cocoon Productivity in Jammu Region. *Biological Forum – An International Journal, 14*(2): 1140-1145.