Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jls.htm
2016 Vol. 6 (4) October-December, pp. 38-45/Sanjai
Research Article

EFFECT OF CLAVIGRALLA GIBBOSA 'SPINY BROWN INFESTED MORUS LEAF ON THE GROWTH AND DEVELOPMENT OF LARVAL PARAMETERS OF SILKWORM

***Sanjai Kumar Gupta**
Department of Zoology, Silkworm/Entomology Laboratory, NSPS Government Post Graduate College, Magarhan, Mirzapur-231306 U.P (India)
**Author for Correspondence: drsanjaigupta1976@gmail.com*

ABSTRACT
Clavigralla gibbosa, a spiny brown insect, has been discovered to be a significant pest of mulberry orchards, impairing the growth and health of mulberry trees and lowering the nutritional content of their leaves. Because mulberry leaves are the silkworm Bombyx mori L. 's major food source, feeding larvae with leaves harmed by this pest has a substantial impact on both the quantity and quality of larval and cocoon production. As a result, this research was conducted to assess the impacts of spiny brown bug infestation on the growth and development of silkworms as well as on widely grown mulberry cultivars. DFLs of commercially significant multivoltine hybrid silkworms were used in the experiment; for each mulberry kind, they were split into two groups: one that consumed healthy leaves and one that consumed infected leaves. Daily measures of larval weight (in grams) were taken during the 3rd, 4th, and 5th instar stages, from the start of feeding through the end of feeding. The measurement included the random selection of ten larvae from each of the infected and control groups. Ten fully developed larvae were collected and counted five days after installation. Under regulated rearing circumstances of 26±1°C, 12±1 hours of light, and 80±5% relative humidity, key larval parameters such larval length, weight, and survivability were evaluated. Ten larvae were chosen at random from each group after feeding on both healthy and infected leaves from four mulberry cultivars to assess their performance and survival throughout various stages. Statistical methods were used to analyze the data gathered from these observations in order to identify varietal variations in larval response.

Keywords: *Silkworm Larval Stages, Larval Weight, Larval Duration, Clavigralla Gibbosa*, *Mulberry.*

INTRODUCTION
Since mulberry trees (Morus spp.) are the sole food source for the silkworm, Bombyx mori, the health and growth of its larvae, as well as the quality of the cocoons they produce, are highly dependent on the state of the mulberry leaves. But mulberry cultivation is frequently hampered by a variety of insect pests that can drastically lower the yield and quality of leaves. Mulberry plants are home to a wide variety of insect species, but just a handful of them cause financial harm. Among these, Clavigralla gibbosa, also known as the Spiny Brown Bug, stands out for its prevalence and significant impact in recent years (Geetha, T. *et al.,* 2015; Govingaiah, Gupta., 2005; and Jadhav, AD, *et al.,* 2010). Because of its brief life cycle, this pest is able to survive all year long, producing symptoms such as stunted growth and deformed foliage. The young larvae often establish themselves on the delicate tips and young leaves of mulberry shoots, where they feed on soft, growing tissue. They frequently live in shelters they create by folding leaves or spinning webs, sometimes rolling the borders of apical leaves into cup-like forms. Clavigralla gibbosa is commonly referred to as the Spiny Brown Bug as a result of its behavior. The worst infestations occur between October and January, and they have been growing year over year, especially in conventional sericulture areas (Narendra kumar, *et al.,* 2011; Moore, S. *et al.,* 1948 and Lowry, OH, et. al 1951). The pest is becoming an increasing concern because it endangers some vegetable crops as well as mulberry. The purpose of this research is to examine how leaf-footed bugs, specifically Clavigralla gibbosa, affect the growth of silkworms and the four major mulberry types, namely Morus alba, Morus indica, Morus

nigra, and Morus serrata. These pests feed on sap by colonizing young shoots, petioles, and the undersides of leaves, causing obvious damage: leaves curl, wrinkle, develop a shiny black coating from honeydew secretions, and eventually become covered in sooty mold (Miller, GI, 1959; Yemm, EW *et al.,* 1954 and Bray, HG, 1954). Affected shoots have twisted; narrow leaves, shortened internodes, and stunted growth. Any deterioration in leaf quality, such as a decrease in nitrogen level, mold infection, or pathogen introduction, can interfere with digestion and nutrient absorption because Bombyx mori is monophagous and needs pure, fresh mulberry leaves. Larvae may avoid damaged leaves, leading to uneven development and lower silk protein output (Arnon, DJ, 1949; B0se, PC, *et al.,* 1989 and Suresh, BR., 1994). Rearers sometimes see poorer cocoon production in practice when rearing on highly infested foliage. Maintaining healthy mulberry trees is essential since the quality of the leaves makes up about 60–70% of the cost of producing cocoons. Nevertheless, the mulberry ecosystem is still susceptible to insect infestations that cause physiological alterations in the leaves, such as nutrient deficiency and decreased photosynthesis. As a result, this study explores the effects of pest-damaged leaves on silkworm feeding habits, larval development, and significant economic indicators like cocoon output.

MATERIALS AND METHODS

The study was conducted in selected on Tarai Belt of Uttar Pradesh Sericulture garden. The infested varietal mulberry leaves were collected randomly forms each Sericulture garden and the same were analyzed for various parameters like growth and development of silkworm bioassay. Bioassay study was conducted on silk worm growth and development and as the parameters observed were larval weight (gm) of 3rd 4th 5th instar larvae, larval duration and survivality of larvae harvested, by feeding both infested and healthy four varietal mulberry plants. The study was conducted in the gardens planted in randomized block design and data was collected from three replications, the statistical data was analyzed in **Two Way ANOVA using Post-hoc test by Microsoft excel online software**.

Effect of Spiny Brown Bug or **leaf footed Bug (**Clavigralla gibbosa**) infested mulberry leaf on the growth and development of silkworm:** This study was conducted by using selected disease free layings (DFLs) of commercially popular Pure Mysore (PM) x NB4D2 **and** Nistari x NB4D2 silkworms and they were divided into two batches of one DFLs for each variety and reared separately with healthy and infested selected popular four varieties of mulberry leaves.

Larval weight (g): Larval weight was recorded every day after first feeding in all the three instars starting from 3rd instar till mounting. For this study ten larvae were randomly selected from control as well as infested just similar identification of 4th and 5th instar larvae each larval stages selected 10 larvae randomly as three replicate and weight the larvae which are healthy and infested by leaf separately.

Larval duration: After hatchability of larvae the tender leaf of mulberry which are healthy and infested feeding varietal mulberry larvae the duration between 1st instar larvae to 5th instar mulberry silkworm larvae identification of day to both varietal feeder of larvae to healthy and infested duration in days.

Survivability percentage of Larvae (Survivability of Larvae): Number of Survived 5th instar larvae were divided by taken 1st instars mulberry silkworm larvae for observation and multiplied by 100 represent as survivality of larvae by healthy and infested larvae three replicate respectively.

$$\text{Survivability of Mulberry silkworm larvae} = \frac{\text{Survived 5}^{\text{th}}\text{ instar larvae}}{\text{1}^{\text{st}}\text{ instar larvae taken for observation}} \times 100$$

RESULTS AND DISCUSSION

As shown in tables, graphs, and figures, the present research discovered that both healthy and pest-infested leaves of *Morus alba, Morus indica, Morus nigra*, and *Morus serrata*—including the Pure

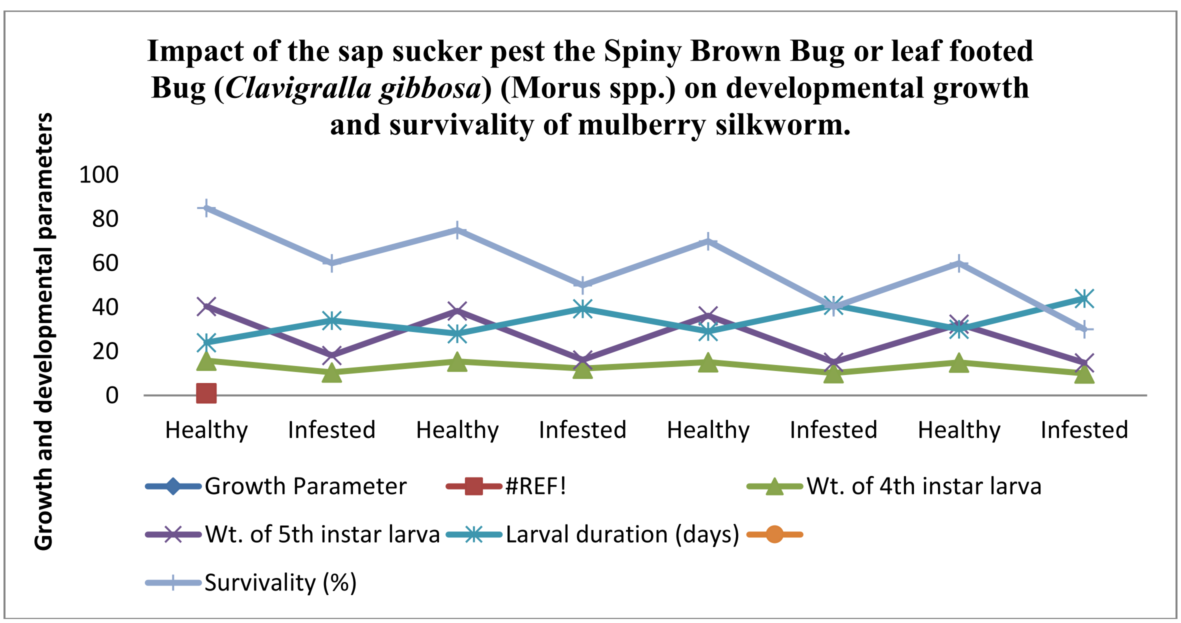
Mysore local mulberry cultivar had a considerable impact on the growth and development of silkworm larvae. It should be mentioned that silkworm culture was significantly impacted by the Spiny Brown Bug, also known as the leaf-footed bug, or *Clavigralla gibbosa*. In comparison to those that ate healthy foliage, larvae that consumed infested leaves from all tested types exhibited obvious developmental deficiencies. On infested leaves, larval weight in the third instar of Morus alba was considerably lower (3.30 g) than on healthy leaves (4.96 g), a 66.50% decrease. Weights decreased similarly by 66.60% throughout the 4th instar, when they were 10.50 g and 15.77 g, respectively. On infested leaves, weights decreased to 18.11 g by the 5th instar, compared to 40.41 g on healthy leaves, representing a 44. 80% decline. The 3rd instar weights for *Morus indica* were 3.22 g (infested) and 4.77 g (healthy), a 32.50% drop. The values decreased by 20.30% between the 4th instar, where they were 12.22 g and 15.33 g. During the 5th instar, weights decreased by 58.00% to 16.11 g and 38.31 g. The weights of the third instar in Morus nigra were 3.11 g and 4.66 g (a 33.30% decrease), the weights of the fourth instar were 10.11 g and 15.13 g (a 33.20% decrease), and the weights of the fifth instar were 15.12 g and 36.14 g (a 58.20% decrease). The third instar weights for Morus serrata were 2. 88 g and 4.11 g (29. 90% reduction), the fourth instar weights were 9.99 g and 14.99 g (33.40% reduction), and the fifth instar weights were 14.82 g and 32.33 g (54.20% reduction). The length of the larval stage depended on the kind and condition of the leaf. The longest time, 44 days, was seen in Morus serrata under infestation, while the shortest, 24 days, was seen in Morus alba when given good leaves. Larvae that ate healthy leaves had the greatest survival rates (85%). However, feeding infected leaves during the fifth instar resulted in 100% death. Due to the lack of naturally occurring antibacterial and antiviral chemicals, poor leaf quality probably made the larvae weaker and more vulnerable to illness. These results corroborate earlier findings by (Myashita, 1986; Umesh kumar., 1990; Gowda, M *et al.,* 1990 and Shree MP Mahadeva., 2015), who found that unpalatable foliage was a major factor in the onset of flacherie and grasserie diseases. The necessity for efficient crop protection measures to assure the delivery of disease-free, high-quality mulberry leaves in order to optimize silk production is highlighted by this research. In contrast, (Aiswariaya, *et al.,* 2007 and Narayanswamy, KC., 2013) found that Brazilian silkworm hybrids had 100% mortality when treated with Chlorantraniliprole at a concentration of 0.2 ppm, but that there was very little mortality (0.00–1.66%) at 0.025 ppm. Due to pathogen consumption, infected leaves exhibited accelerated protein degradation, which led to a decreased protein concentration. Lower photosynthetic activity can result in decreased carbohydrate levels, which are essential for the health of silkworms and the production of cocoons (Anusha, HG. *et al.,* 2015). Infested plants had much higher levels of phenolic compounds, which are involved in plant defense, and may have induced hypersensitive reactions against leaf webber and other pests (Bandyoopadhyay, UK, *et al.,* 2000; Dandin, SB, *et al.,* 2000). Significant negative effects on larval development and cocoon formation resulted from eating leaf webber-damaged foliage. The cocoons that were made were of poor quality, with smaller, discontinuous filaments, less compact structure, and a greater likelihood of breaking when reeling. These results indicate lower nutritional content in impacted leaves. In general, mite infestation appears to be a major limitation in the production of high-quality mulberry leaves, which has a direct impact on the quantity and quality of silk cocoons. More study is necessary to completely understand how mite damage impacts the behavior of young silkworms and its overall effects on sericulture.

CONCLUSION

In this research, which compared three types, Morus alba, and Morus indica the leaf footed bug, sometimes known as the spiny brown bug (*Clavigralla gibbosa*), was discovered to have the worst effect on the Morus alba mulberry variety. The physiological parameters measured when given to third instar silkworms showed that pest infestation caused the greatest decline in photosynthetic pigments in Morus alba (66.50%), followed by *Morus indica* (32.50%), *Morus nigra* (33.30%), and *Morus serrata* (29.90%). The pest had a significant physiological impact on each of the four mulberry varieties. The results indicate that *Clavigralla gibbosa* has a significant impact on mulberry plants, changing their nutritional makeup, growth, and metabolic activity across all of the tested cultivars: Morus alba, Morus indica, Morus nigra, and Morus serrata. Infestation reduces the quantity and quality of leaves, which has a detrimental effect on silkworm development and cocoon production, ultimately resulting in financial losses for sericulture farmers and the silk industry.

Table: Impact of the sap sucker pest the Spiny Brown Bug or leaf footed Bug (Clavigralla gibbosa) (Morus spp.) on developmental growth and survivality of mulberry silkworm.

Growth Parameter	**Morus alba**			**Morus indica**			**Morus nigra**			**Morus serrata**		
	Healthy	Infested	% of loss/ weight increase duration	Healthy	Infested	% of loss/ weight increase duration	Healthy	Infested	% of loss/ weight increase duration	Healthy	Infested	% of loss/ weight increase duration
Wt. of 3rd instar larva	4.96	3.30	66.50	4.77	3.22	32.50	4.66	3.11	33.30	4.11	2.88	29.90
Wt. of 4th instar larva	15.77	10.50	66.60	15.33	12.22	20.30	15.13	10.11	33.20	14.99	9.99	33.40
Wt. of 5th instar larva	40.41	18.11	44.80	38.31	16.11	58.00	36.14	15.12	58.20	32.33	14.82	54.20
Larval duration (days)	24	34	141.70 Increase	28	39.30	39.30 Increase	29	41	41.40 Increase	30	44	46.70 Increase
Survivality (%)	85	60	70.60	75	50	33.30	70	40	42.90	60	30	50.00



Two factor ANOVA Factor 2 Mean

		Healthy	Infested	Healthy	Infested	Healthy	Infested	Healthy	Infested	
	Wt. of 3rd instar larva	4.990	3.360	4.880	3.330	4.770	3.330	4.220	2.920	3.975
	Wt. of 4th instar larva	15.880	10.600	15.443	12.330	15.227	10.173	15.017	10.073	13.093
Factor 1	Wt. of 5th instar larva	40.507	18.187	38.360	16.220	36.230	15.187	32.550	14.940	26.523
	Larval duration (days)	25.000	35.000	29.000	40.100	30.000	42.000	31.000	45.000	34.638
	Survivality (%)	87.333	61.333	77.333	52.333	72.667	41.667	62.667	31.667	60.875
		34.742	25.696	33.003	24.863	31.779	22.471	29.091	20.920	27.821

ANOVA table

Source	**SS**	**df**	**MS**	**F**	**p-value**
Factor 1	46,230.3803	4	11,557.59507	9119.83	1.64E-105
Factor 2	2,723.1314	7	389.01877	306.97	4.92E-55
Interaction	8,421.1819	28	300.75650	237.32	7.50E-66
Error	101.3843	80	1.26730		
Total	57,476.0779	119			

Post hoc analysis for Factor 1

Tukey simultaneous comparison t-values (d.f. = 80)

		Wt. of 3rd instar larva	Wt. of 4th instar larva	Wt. of 5th instar larva	Larval duration (days)	Survivality (%)
		3.975	13.093	26.523	34.638	60.875
Wt. of 3rd instar larva	3.975					
Wt. of 4th instar larva	13.093	28.06				
Wt. of 5th instar larva	26.523	69.38	41.33			
Larval duration (days)	34.638	94.35	66.30	24.97		
Survivality (%)	60.875	175.09	147.03	105.71	80.74	

critical values for experiment wise error rate:

		0.05	2.80
		0.01	3.38

p-values for pair wise t-tests

		Wt. of 3rd instar larva	Wt. of 4th instar larva	Wt. of 5th instar larva	Larval duration (days)	Survivality (%)
		3.975	13.093	26.523	34.638	60.875
Wt. of 3rd instar larva	3.975					

Wt. of 4th instar larva	13.093	3.70E-43				
Wt. of 5th instar larva	26.523	3.09E-73	9.77E-56			
Larval duration (days)	34.638	8.68E-84	1.11E-71	1.61E-39		
Survivality (%)	60.875	3.69E-105	4.13E-99	1.05E-87	1.98E-78	

Post hoc analysis for Factor 2										
Tukey simultaneous comparison t-values (d.f. = 80)										
		Infested	Infested	Infested	Infested	Healthy	Healthy	Healthy	Healthy	
		20.920	22.471	24.863	25.696	29.091	31.779	33.003	34.742	
Infested	20.920									
Infested	22.471	3.77								
Infested	24.863	9.59	5.82							
Infested	25.696	11.62	7.84	2.03						
Healthy	29.091	19.88	16.10	10.29	8.26					
Healthy	31.779	26.42	22.64	16.82	14.80	6.54				
Healthy	33.003	29.40	25.62	19.80	17.78	9.52	2.98			
Healthy	34.742	33.62	29.85	24.03	22.01	13.75	7.21	4.23		
critical values for experiment wise error rate:										
		0.05	3.12							
		0.01	3.68							
p-values for pairwise t-tests										
		Infested	Infested	Infested	Infested	Healthy	Healthy	Healthy	Healthy	
		20.920	22.471	24.863	25.696	29.091	31.779	33.003	34.742	
Infested	20.920									
Infested	22.471	.0003								
Infested	24.863	6.07E-15	1.18E-07							
Infested	25.696	7.48E-19	1.63E-11	.0460						
Healthy	29.091	1.10E-32	8.05E-27	2.69E-16	2.52E-12					
Healthy	31.779	2.89E-41	1.55E-36	5.32E-28	1.30E-24	5.37E-09				
Healthy	33.003	1.23E-44	2.58E-40	1.40E-32	1.63E-29	8.44E-15	.0038			
Healthy	34.742	5.84E-49	3.99E-45	2.41E-38	1.11E-35	9.04E-23	2.81E-10	.0001		

The above statistical table states that healthy mulberry leaves have much higher trait reading then infested ones, and the difference is robust. The biological expectation that the pest hurts leaves quality, which then feeds into the economic impact for sericulture mentioned earlier rearers for sericulturist.

ACKNOWLEDGEMENT
I have incredible joy and advantage in communicating my profound feeling of appreciation and true respect to the most powerful individual in my postgraduate vocation, my companion's guide and my folks.

REFERENCES

Agrios GN (1969). How plants defense themselves against pathogen in G.N. Agrios, (Ed.) *Plant Pathology. Academy Press. New York*. 93-112.

Aiswariaya, K.K., Manjunatha, M., Mohan, Naik, I. (2007) Biology and host range of spiralling whitefly.Karnataka *Journal of Agricultural Sciences*. **20(1)** 149 – 152.

Anusha, H. G. and Bhaskar, R. N. (2015) Sucking pests of mulberry: A review. *IOSR Journal of Agriculture and Veterinary Science*, **8(8)** 1-3.
Arnon DJ, 1949). Copper enzymes in isolated chloroplasts. Polyphenoloxidase in *Beta vulgaris*. *Plant Physiology* **24** 1-15.
Bandyopadhyay, U. K., Sahu, P. K., Raina, S. K., Santhakumar, M. V., Chakraborty, N. and Saratchandra, B. (2000) Studies on the seasonal incidence of the whitefly, (Dialeuropora decempuncta (Q. & B.) causing leaf curl on mulberry in relation to abiotic factors. *International Journal of Industrial Entomology*, **1(1)** 65-71.
Bose PC, Majumdar SK (1989). Requirements of Amino acid in silkworm (*Bombyx mori*) nutrition. *Indian Silk*. **28** 41-43.
Bray HG, (1954). Thorpe WV.Analysis of phenolic compounds of interest in metabolism. *Methods Biochem Anal.* 1 27-52.
Dandin, S. B., Jayaswal, J. and Giridhar, K. (2000) Hand Book of Sericulture Technologies. Central Silk Board, Bangalore, Karnataka (India).
David, B.V., Ramamurthy, V.V. (2011) Elements of Economic Entomology 6th Edition, *Namrutha Publications, Chennai, Tamil Nadu*.
Geetha, T., Mahalingam, C.A. and Murugan, N. (2015) Biology of mulberry thrips, (Pseudodendrothrips mori Niwa) under Tamil Nadu climatic condition *International Journal of Agricultural Science and Research*, **5**(2) 19-26.
Govindaiah, Gupta, V.P., Sharma, D.D., Rajadurai, S. and Naik, V.N. (2005). Mulberry crop protection. *Central Silk Board Publication, Bangalore*.
Gowda M, Kumari MS, Kumar UNN, Boraiah G (1990). Changes in total phenolics of tukra-affected mulberry plats. *Sericologia*. **30** 263-266.
Jadhav, A. D., Dubal, R.S., Bagade, R. P., Sanadi Reshma, A., Kamble, P.L., Mani, M. (2010) Origin, introduction, distribution and management of the invasive spiralling whitefly Aleurodicus dispersus Russell in India. *Karnataka Journal of Agricultural Sciences*, **23(1)** 59-75.
Lowry OH, Rosebrough NJ, Farr AL, Randall RJ (1951). Protein measurement with Folin-phenol reagent. *Journal of Biological Chemistry*. **193** 265-275.
Miller GL (1959). Use of dinitro-salicylic acid reagent for determination of reducing sugars. *Analytical Chemistry*. **31** 426-428.
Miyashita Y, (1986) A report on mulberry cultivation and training methods suitable to bivoltine rearing in Karnataka, 1-7.
Moore S, Stein WH, (1948). Photometric ninhydrin method for use in chromatography of amino acid. *Journal of Biological Chemistry*. **176** 367-388.
Narayanaswamy KC (2013). Biochemical composition of leaf roller infested mulberry leaf. *Insect Environment*. **8:** 166-167.
Narendra Kumar, J.B., Shekhar, M.A and Qadri, S.M.H. (2011). Giant African snail in Mulberry: Physiology and management. *Indian Silk*, **1 (12)** 4-5.
Shree MP, Mahadeva A, (2015) Impact of jassids (Empoasca flavescens F.) infestation on the biochemical constituents and photosynthetic pigments of mulberry (Morus sp.) foliage. *Insect Environment.* **11** 91-92.
Suresh BR, David D, Vivekanandan M, (1994). Changes in morphophysiology, water relations and nutrients in 'tukra' diseased leaves of a few mulberry varieties. *Journal of Sericultural Science of Japan.* **63** 183-184.
Umesh Kumar NN, Shree MP, Muthegowda M, Boraiah G. (1990). Changes in proteins, sugars, phenols and total chlorophyll content of mulberry plants affected by "tukra". *Indian Journal of Sericulture.* 29 93-100.

Yemm EW, Willis AJ, (1954). The estimation of carbohydrates in plant extracts by anthrone. *Biochemistry Journal* **57** 508-514.