EFFECT OF MITE INFESTED MULBERRY LEAVES ON REARING PERFORMANCE AND REELING PARAMETERS OF SILKWORM, *BOMBYX MORI* L.

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ABSTRACT: Silkworms of $SH_6 \times NB_4D_2$ hybrid were reared with mulberry leaves of selected varieties damaged by phytophagous mites to varied intensity during autumn season of 2010 and 2011 at CSR & TI, Pampore, Kashmir, India. Results revealed distinct differences in the silkworm biological and economic parameters *viz.,* larval duration, larval weight, cocoon weight, shell weight, shell ratio, filament length and denier. Some more observations on the biological parameters shown concern as the mite damage in mulberry may increase disease susceptibility, feed requirement and labour besides the reduced yield and quality. Increased disease susceptibility, feed requirement and labour were observed when fed with the mite damaged mulberry leaves.

KEY WORDS: Mulberry, mite damage, *Bombyx mori*, rearing performance, reeling parameters.

Mulberry (*Morus* spp.) leaves forms the only food material for the silkworm, *Bombyx mori* L. For the development of silk industry, production of quality silkworm cocoons is must. To achieve the goal of production of good quality silkworm cocoon crop, certain factors play important role. The most important factor is the mulberry leaf, contributing about 38.2% followed by climate (37.0%), rearing techniques (9.3%), silkworm race (4.2%), silkworm egg (3.1%) and other factors (8.2%) in producing good quality cocoons (Miyashata, 1986). Hence, quality as well as quantity of mulberry leaf is one of the basic pre-requisite of sericulture and play a pivotal role for successful silkworm cocoon crop. Healthy mulberry leaves influences the growth, development and quality of cocoons formed and thus decide the superiority of silk to a greater extent (Khan et al., 2004). The quality of mulberry leaf is influenced by several factors such as variety, agronomic practices, biotic and abiotic components (Krishnaswami et al., 1970). A number of pests and diseases have been reported on mulberry (Sharma & Sharma, 1989; Teotia & Sen, 1994). So for, more than 300 species of insect and non-insect species are reported to infest one or the other part of the mulberry plant (Reddy & Narayanaswamy, 1999). Besides other pests of mulberry foliage, mites belonging to families of Tetranychidae and Eriophyidae are found to cause mulberry leaf damage to the tune of 5-10% in India (Narayanaswamy et al., 1996). In Kashmir valley, *Tetranychus* sp. has been reported to attack mulberry (Khan et al., 2004) but, very little information is available on the seasonality and damage potential to mulberry and silkworm (Dar et al., 2011a,b). They cause a symptom of speckling of leaves which can be easily identified. Information on the effect of feeding silkworm with mulberry leaves damaged by mites on the larval/ cocoon

characters is very scanty. Now, the Indian government and Jammu and Kashmir administration are planning to popularise and promote the second and third crops of sericulture in the state owing to the salubrious climate bestowed utilising the available mulberry wealth with its improved management techniques (Malik et al., 2010; Khan et al., 2010; Raina et al., 2011; Rajat Mohan et al., 2011). Now, the emphasis given for the mulberry improvement to facilitate the second and third crops in Kashmir valley. With this background, the present study was taken up during Autumn seasons of 2010 of 2011 at Entomology and Pathology Laboratory, CSR&TI, Pampore, Jammu and Kashmir, which is located in the temperate climatic conditions of J&K, a traditional sericultural state, to know the impact of varied degree of mite damage to mulberry leaf on one of the ruling hybrid of the valley, $SH_6 \times NB_4D_2$.

MATERIALS AND METHODS

The larvae of hybrid silkworms SH_6 x NB_4D_2 were reared on leaves of five mulberry varieties *viz*., Goshoerami, Kairyonezaemigaeshi (KNG), Tr10, Ichinose and Chinese white to know the effect of feeding with mite infested leaves on the larval performance and cocoon characters from August to October 2010. Eggs of popular silkworm hybrid of the valley, SH_6 x NB_4D_2 were obtained from Silkworm Breeding and Genetics section, CSR & TI, Pampore and were incubated in BOD incubator (Modern Industrial Corporation, India) following the standard procedures (Dandin & Giridhar, 2010). Twenty disease free layings (DFLs) of silkworm seed were incubated. Upon hatching, two DFLs were brushed in to one rearing tray and accordingly a total of ten trays were maintained. These ten trays were divided into two batches keeping five trays in a batch. Each batch of five rearing trays formed a treatment, by providing mite infested and healthy leaves, respectively. Healthy leaves were free from the speckles, which is the characteristic symptom of mite injury while, the infested leaves had lamina spread with speckles of varied intensity. Mulberry leaves of five varieties were chopped to a size of 0.5 cm^2 and spread over the hatched silkworm larvae in a single layer. The silkworm rearing was performed in room with temperature of 25 ± 1˚C and relative humidity of 85 ± 5 % under control facilities following the standard procedures (Dandin & Giridhar, 2010). All the resultant data was subjected to t- test using *MSTATC*® software.

During the second year (Autumn 2011), silkworms of hybrid SH_6 x NB_4D_2 were reared on leaves mulberry varieties Goshoerami, KNG and Ichinose with varied mite damage intensity following the standard protocol mentioned above. As there were no plants and varieties free of mite during 2011, four treatments were designed based on the damage intensity (Table 2). Only 100 larvae were maintained per tray after second moult and rearing as per standards (Dandin & Giridhar, 2010). The resultant data was analysed using factorial design after necessary transformations and the means were ranked with least significant difference (lsd) at five percent probability using *MSTATC*® software.

RESULTS AND DISCUSSION

The rearing performance of silkworm larvae fed with mite damaged and healthy mulberry leaves from five varieties and the resultant cocoon parameters during 2010 are presented in Table 1 and the same fed with mulberry leaves with varied mite damage intensity during 2011 is presented in Table 2.

Bioassay studies during 2010 clearly established that the mite infestation on mulberry leaves adversely affected the economic characters of silkworm larvae and cocoon of SH_6 x NB_4D_2. The larval period was prolonged significantly by three days when silkworm were fed with the mite infested leaves than those fed with non infested leaves. The larval weight was reduced by 1.26 g, which is statistically significant (Table 1). All the economic characters of the cocoon were affected significantly due to feeding the silkworm with mite infested leaves. The larval period was significantly shorter for the larvae fed on healthy leaves. The larval weight and all economic cocoon traits studied *viz*., cocoon weight, shell weight, shell ratio, filament length and denier are adversely affected due to feeding silkworm larvae with mite infested leaves. The shell weight and cocoon weight reduction was 0.5 g and 0.114 g, respectively. The shell ratio was reduced by 4 %; filament length was reduced by 260 m on the cocoon obtained from silkworm fed with mite infested leaves. The denier was reduced by 1.1 due to feeding with mite damaged leaves.

Similarly, during 2011 the results clearly indicated the detrimental impact of mite infestation in mulberry on the biological and economic parameters of silkworm hybrid, SH_6 x NB_4D_2 (Table 2). There existed a significant difference in larval duration, larval weight, good cocoon weight, good cocoon weight, single cocoon weight, single shell weight, shell ratio, filament length and denier among the treatments. The amount of deterioration in various parameters under consideration is observed as a function of damage severity inflicted by mites. The results study clearly indicated a need for in depth systematic investigations on the impact of mite damage to leaf quality as well as the biological and economical parameters of silkworm rearing.

These studies borrow the support from the findings of Nangia & Nageshchandra (1990) who have documented that mite attacked leaves reduced the economic parameters significantly. In an another study in China on the impact of mite infestation, it has been estimated that silk production would be reduced by approximately 15 and 35% if the accumulative infestation of *T. kanzawai* reached 190 and 539 mite-days, respectively, when *B. mori* moulted into the 3rd larval instar (Ho et al., 1989).

Bioassay studies during spring and autumn seasons at this Institute have established that, the mulberry varieties *viz*., KNG and Ichinose are far more superior than the Goshoerami variety with respect to majority of cocoon paameters and few larval characters of silkworm hybrid, SH_6 x NB_4D_2 (Anon., 1999, 2000 and 2001). In present study Ichinose (T_4) (Table 2) with relatively lower damage than Goshoerami (T_2) performed on par or inferior with respect to all the parameters under consideration clearly demonstrates the deleterious effect of mite on the leaf quality. KNG (T_3) which is least damaged by mite, maintained superiority over rest of the treatments. With respect to the filament length the least damaged KNG (T_3) registered the lowest next only to the severely damaged treatments (T_2 & T_4) clearly indicates the sensitivity of the silkworm even to the slightest leaf damage by mites. Studies clearly indicated that, the performance on Ichinose variety is pulled down significantly even though the damage is relatively lower indicating the need for in-depth studies on the impact of varied levels of mite infestation on various commercial varieties of mulberry.

During the investigations, it was also observed that the survival of chawki worms was distinctly low when fed with mite damaged leaves. Extended moulting periods on damaged leaf besides extended larval duration required more feed which are need to be ascertained in depth to measure the damage potential.

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LITERATURE CITED

Anonymous. 1999. Annual Report- 1998-99. Central Sericultural Research and Training Institute, Pampore, Jammu and Kashmir, India, pp. 91-92.

Anonymous. 2000. Annual Report- 1999-2000. Central Sericultural Research and Training Institute, Pampore, Jammu and Kashmir, India, pp. 71-72.

Anonymous. 2001. Annual Report- 2000-2001. Central Sericultural Research and Training Institute, Pampore, Jammu and Kashmir, India, pp. 53-54.

Anonymous. 2011. Annual Report 2010-11. Central Silk Board, Bangalore, Karnataka, India, pp. 95.

Dandin, S. B. & Giridhar, K. 2010. Hand Book of Sericulture Technologies. Central Silk Board, Bangalore, Karnataka, India, 427 p.

Ho, C. C., Hwang, S. C. & Wang, S. H. 1989. Effect of the infestation of *Tetranychus kanzawai* Kishida (Acarina: Tetranychidae) on the silk production of the silkworm, *Bombyx mori* (L.) (Lepidoptera: Bombycidae). Chinese Journal of Entomology, 9 (2): 203-209.

Khan, M. A., Dhar, A. & Mir, N. A. 2010, Constraints and strategies for multiple cocoon crops in Jammu and Kashmir State. In Proceedings of the workshop on multiple cocoon crops for sustainable sericulture in Jammu and Kashmir stat. 18th October 2010, Srinagar, Jammu and Kashmir, India, pp. 4-8.

Khan, M. A., Dhar, A., Zeya, S. B. & Trag, A. R. 2004. Pest and diseases of mulberry and their management. Bishen Singh Mahendra Pal Singh, Dehradun, India, 68 p.

Krishnaswami, S., Noamani, M. K. R. & Ahsan, M. 1970. Studies on the quality of mulberry leaves and silkworm crop production, Part-I: quality differences due to varieties. Indian Journal of Sericulture, 9 (1): 1-10.

Malik, M. A., Kamili, A. S., Sofi, A. M., Malik, G. N., Sabhat, A., Ahmad, S. & Malik, F. A. 2010. Second Commercial Silkworm Rearing in Kashmir- A Ray of Hope. Indian Silk, 48 (9): 10-11.

Miyashata, Y. 1986. A report on mulberry cultivation and training methods suitable to bivoltine rearing in Karnataka. Central Silk Board, Bangalore, India, pp. 1-7.

Mohan, R., Dhar, A., Tayal, M. K., Chauhan, T. P. S., Raina, S. K. & Khan, M. A. 2011. Pruning technology – A tool for Introduction of third crop Jammu Region. In: Proceedings of the workshop on recent trends in development of Sericulture in Jammu and Kashmir. 29th October 2011, Department of Sericulture, Government of Jammu and Kashmir, Srinagar, Jammu and Kashmir, India, pp. 40-44.

Nangia, N. & Nageshchandra, B. K. 1989. Effect of mulberry varieties attacked by the spider mite *Tetranynchus ludeni* Zacher on the cocoon characters of *Bombyx mori* L. (Race: NB18). Indian Journal of Sericulture, 29 (1): 30-36.

Narayanswamy, K. C., Geethabai, M. & Raghuraman, R. 1996. Mite pests of mulberry - A Review. Indian Journal of Sericulture, 35 (1): 1-8.

Raina, S. K., Chauhan, T. P. S., Tayal, M. K., Pandey, R. K. & Mohan, R. 2011. Multiple Silkworm Cocoon Cropping in Jammu Division. In: Proceedings of the workshop on recent trends in

development of Sericulture in Jammu and Kashmir. 29th October 2011, Department of Sericulture, Government of Jammu and Kashmir, Srinagar, Jammu and Kashmir, India, pp. 63-67.

Reddy, D. N. R. & Narayanaswamy, K. C. 1999. Present status of the thrips infesting mulberry. Indian Journal of Sericulture, 38: 1-7.

Sharma, B. & Sharma, S. 1989. Entomological Investigations done in India along with a checklist of insect pests attacking mulberry plants in the world. In: The University Review (Science), University of Jammu, Jammu, India, pp. 183-193.

Teotia, R. S. & Sen, S. K. 1994. Mulberry diseases in India and their control. Sericologia, 34 (1): 1-18.

Table 1. Effect of mite infested mulberry leaves on the larval and cocoon parameters of silkworm hybrid $SH_6 \times NB_4D_2$, during 2010.

Variety	Larval period (Days- Hrs)		Larval weight/(g)		Cocoon weight/(g)		Shell weight/(g)		Shell ratio		Filament length (m)		Denier	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Ichinose	26-4	29-2	4.14	2.84	1.80	1.19	0.35	0.16	19.4	13.4	857	616	2.98	1.66
Goshoeramı	26-5	29-1	4.29	2.98	1.80	1.22	0.32	0.17	17.7	13.9	900	710	2.73	1.64
Tr10	26-7	29-3	4.05	3.00	1.76	1.33	0.31	0.17	17.6	12.78	895	689	2.75	1.85
Chinese white	26-6	29-4	4.13	2.76	1.71	1.21	0.29	0.17	16.9	14.0	887	555	2.88	1.49
KNG	26-3	29-00	4.17	2.90	1.81	1.28	0.30	0.18	16.6	14.0	967	618	2.75	1.94
Mean	26.5	29.2	4.16	2.90	1.78	1.25	0.31	0.17	17.64	13.62	901.2	637.6	2.82	1.72
Standard deviation	1.34	1.34	0.871	0.994	0.042	0.058	0.023	0.007	1.088	0.522	40.388	62.364	0.108	0.179
Variance	1.8	1.8	0.758	0.988	0.002	0.003	0.001	0.00	1.183	0.272	1631.2	3889.3	0.012	0.032
t-test	*		*		*		*		*		*		*	

* = Significant at p = 0.05
A= Healthy mulberry leaves (Free from speckles)
B= Mite Infested mulberry leaves (Leaves with varied number of speckles spread over lamina)

Table 2. Effect of mite infested mulberry leaves with varied damage intensity on the larval and cocoon parameters of silkworm hybrid $SH_6 \times NB_4D_2$, during 2011.

Treatment	Larval Duration (d:hr)	Larval Weight (g)	No. of diseased larvae*	Good Cocoons (%)*	Good Cocoon Weight (g/100 larvae)	Single Cocoon Weight (g)	Single Shell Weight (g)	Shell Ratio (%)	Filament length (m)	Denier
T_1. Goshoerami (around 20% of leaves with scattered speckles).	$24:02^{A}$	3.55^{AB}	0.00^{A}	88.20^{AB}	180.39^{A}	1.54^{B}	0.27^{B}	17.26^{B}	930.2^{A}	2.542^{AB}
T_2. Goshoerami (>50% leaves severely curled, crinkled, reduced leaf lamina and leathery texture).	$24:23^{C}$	3.28^{C}	1.20^{AB}	81.00^{B}	140.68^{B}	1.55^{B}	0.26^{B}	16.68^{C}	909.2^{AB}	2.466^{B}
T_3. KNG (<10% of leaves with scattered speckles)	$24:10^{B}$	3.64^{A}	0.00^{A}	90.20^{A}	169.60^{A}	1.69^{A}	0.30^{A}	17.81^{A}	874.6^{B}	2.764^{A}
T_4. Ichinose (all most all leaves with speckles spread over the lamina)	$26:01^{D}$	3.38^{BC}	1.40^{B}	88.60^{AB}	156.59^{A}	1.55^{B}	0.27^{B}	17.07^{BC}	921.6^{AB}	2.620^{AB}

Means superscripted with same alphabet(s) at statistical indifferent from each other by lsd at p=0.05.
* Analysed with square root and angular transformed values