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SeriMore- An Effective Plant Based Growth Promoter for Increasing an Economic Character of Silkworm *Bombyx mori L* in Large Scale in Different Seasons

Dr. Mousumi Mondal
moumons@gmail.com
HealthLine Pvt Ltd., Bangalore

Prof. Narayanswamy K
kcn_uas@yahoo.co.in
GKVK, Bangalore

Bharat Tandon
hlplresearchfarm@gmail.com
HealthLine Pvt Ltd., Bangalore

ABSTRACT

The application of SeriMore on Bombyx mori larvae has been proved to be significance in the sericulture industry. SeriMore is a plant extract based growth Promoter formulation based on bakuchiol extracted from Psoralea coryllifolia, necessary nutritional components and synergistic factors. The effect of a SeriMore (0.1 µl/silkworm larvae) was tested on popular hybrid PMxCSR2 in extensive large-scale field trials conducted in different areas of Karnataka & Andhra Pradesh in different seasons. The result indicated an extension of the larval duration in the range of 18-24 hrs, cocoon yield improvement of up to 12-16% and 8-10% higher returns in price compared to control cocoons. The SeriMore treated batches also showed significant improvement in a number of cocoons/kg compared to the control group.

Keywords: *Silkworm, SeriMore, Plant Extract, Cocoon, Growth Promoter.*

1. INTRODUCTION

Silkworm growth regulators (SGRs) such as juvenile and molting hormones or their analogs (juvenoids and ecdysoids) when used judiciously have been found to be useful in sericulture industry. The silk production in India needs improvement in quantity as well as quality compared to other major silk producing countries. Sericare Division, Healthline Pvt. Ltd has been involved in the improvement of the mulberry and sericulture technology in a holistic way. The silkworm, *Bombyx mori* is known to exhibit a stimulatory effect on the administration of exogenous JH analogs in minute quantities which lead to enhancement in commercial traits such as cocoon weight, cocoon shell weight and silk filament length (Akai *et al*., 1985; Mamatha *et al*., 2005; 2008).

The physiological balance of juvenile hormone (JH) in insects depends on its biosynthesis and degradation pathway (Jun *et al*., 2011). There are several Indian studies on this subject like, study of juvenile hormone (JH) mimic R394 (ethyl 9-cyclohexyl-3, 7-dimethy l-2, 4-nonadienoate) applied topically on the abdominal tergum of silkworm (*Bombyx mori L*., after the fourth ecdysis (Trivedy *et al*., 1997); study of improvement in cocoon yield induced by a Juvenile Hormone Analogue, SB-515 in the bivoltine Silkworm (*Bombyx mori L*.) hybrid, CSR2 x CSR4 and its reciprocal combination (Nair *et al*.,2012); synthetic juvenile hormone mediated enhancement and manifestation of commercial traits of CSR2 x MG408 and CSR4 x MU852 productive bivoltine silkworm hybrids (Nagendraradhya and Kumar,2013). One of the latest interesting studies is on using phyto-Juvenile hormone mimics for augmentation in cocoon yield in silkworm, *Bombyx mor*i (Nair *et al*, 2010). The authors have used juvenile hormone (JH) mimic of ω-formyl longifolene oxime propargyl ether (NL13), derived from longifolene, present in Indian turpentine oil, (extracted from *Pinus longifolia)* and bakuchiol, isolated from the medicinal weed, *Psoralea coryllifolia*. These compounds were administered in various concentrations to the fifth instar larvae of bivoltine silkworm hybrid, KA x NB4D2 at 24, 48, 72 and 96 h at the rate of 12.5 ml/100 larvae. Almost at the same time, we have developed SeriMore, a formulation based on bakuchiol extracted from *Psoralea coryllifolia*, necessary nutritional components, and synergistic factors. The product was tested on PM x CSR2 hybrid at GKVK, Bangalore and subsequently at CSR&TI, Mysore (results are being published separately). The results of the GKVK studies indicated an increase in economic characters like cocoon weight, shell weight, shell ratio, reelability percentage and silk filament length, (17.57%, 23.52%, 5.99%, 6.18% and 13.89% respectively) over control. The result of CSR&TI studies also showed an increase in cocoon weight, shell weight, shell ratio, reelability percentage and silk filament length (11.07%, 13.89%, 2.186%, 6.67%, and 13% respectively) over control. The present study is aimed at studying the efficacy of Serimore under field conditions and to correlate with economical aspects from the view point of sericulture farmers. The

major objective of this multi-centric study was to determine the effect of SeriMore in large scale in different seasons in comparison to the conventional rearing techniques as a control.

2. MATERIAL AND METHODOLOGY

The cross breed (multivoltine x bivoltine) PM x CSR2 was chosen for the present study. SeriMore was administered in a single dose at 48h after 4th moult at concentrations of 0.1 µl/silkworm larvae (5 ml SeriMore dissolved in 2.5 liters potable water and sprayed on to the silkworm). The control batches were maintained to compare the results. The cross breeds PM x CSR2 studies were conducted in four different districts viz. Mandya, Kolar, Chickballapur and Bangalore Rural of Karnataka and Hindupur area of Andhra Pradesh. In each district, the trial was conducted with 5000 dfls as control and 5000 dfls treated with SeriMore. 10 male cocoons and 10 female cocoons were collected from each farmer and the average value is taken for every criterion. The overall average value was calculated by taking average data from all the farmers. The economical parameters of SeriMore treated batches *viz*. a number of cocoons per kg cocoon, cocoon weight, shell weight, SR%, cocoon yield, cocoon price and net profit was recorded after the cocoons were brought to the market and compared the results with the control batches.

3. RESULTS AND DISCUSSION

SeriMore showed a significant positive response in larval and cocoon characters in all the four districts, where trials were conducted. The data on the effect of the application of SeriMore on the economic traits of silkworm hybrid PM x CSR2 are presented in Tables 1, 2, 3, 4 and 5. It was observed that SeriMore extended the larval feeding period in the range of 18-24 hours than control batches. The number of cocoons per kg was less than the control batches in all the trials.

The average number of cocoons per kg was found to be 45-60 nos of cocoons more in control batches than SeriMore treated batches in all area of Karnataka and Andhra Pradesh.

The average cocoon weight, shell weight and SR % of SeriMore treated batches were more in than control respected to all seasons.(Table 1,2, 3, 4,5 and Fig 1 and 2). It was found that Cocoon weight, shell weight, and SR% were more in winter followed summer and rainy seasons in all area of Karnataka and Andhra Pradesh.

Fig: 1 SeriMore Ampoules

Fig: 2 SeriMore and Control Cocoons

Table 1: Cocoon Weight, Shell Weight, SR% and No of Cocoons/kg in Different Seasons in Bangalore Rural Area in Karnataka

Seasons (S)	Treatment (T)	Cocoon weight (g)			Shell weight(g)			SR%			No of cocoons/kg		
Summer	SeriMore	1.96			0.387			19.68			511.2		
	Control	1.83			0.332			18.19			569		
Winter	SeriMore	1.97			0.39			19.75			507.6		
	Control	1.86			0.342			18.37			564.6		
Rainy	SeriMore	1.88			0.359			18.54			531.6		
	Control	1.76			0.305			17.38			591.4		
		S	T	S x T	S	T	S x T	S	T	S x T	S	T	S x T
F -Test		*	*	NS	*	*	NS	*	*	NS	*	*	NS
SEm±		0.01	0.01	0.01	0.01	0.01	0.01	0.11	0.09	0.15	1.23	1	1.74
CD at 5%		0.02	0.02	NS	0.01	0.01	NS	0.32	0.26	NS	3.62	2.96	NS
CV(%)		1.06			2.17			1.62			0.64		

*** Significant at 5% label, N S: Non Significant**

Table 2: Cocoon Weight, Shell Weight, SR% and No of Cocoons/kg in Different Seasons in Chickballapura District in Karnataka

Seasons (S)	Treatment (T)	Cocoon weight (g)			Shell weight (g)			SR%			No of cocoon/kg		
Summer	SeriMore	1.94			0.37			19.32			516.6		
	Control	1.81			0.33			18.21			568.2		
Winter	SeriMore	1.96			0.39			19.71			511		
	Control	1.82			0.33			18.29			565.2		
Rainy	SeriMore	1.87			0.35			18.79			530.8		
	Control	1.75			0.31			17.62			584.6		
		S	T	S x T	S	T	S x T	S	T	S x T	S	T	S x T
F -Test		*	*	NS	*	*	NS	*	*	NS	*	*	NS
SEm±		0	0	0.01	0	0	0	0.06	0.05	0.09	0.81	0.67	1.15
CD at 5%		0.01	0.01	NS	0.01	0	0.01	0.19	0.15	NS	2.4	1.96	NS
CV (%)		0.71			1.49			0.96			0.42		

Table 3: Cocoon Weight, Shell Weight, SR% and No of Cocoons/kg in Different Seasons in Mandya District in Karnataka

Seasons (S)	Treatment (T)	Cocoon weight (g)			Shell weight (g)			SR%			No of cocoon/kg		
Summer	SeriMore	1.93			0.37			19.4			520.2		
	Control	1.81			0.33			18,20			568		
Winter	SeriMore	1.95			0.38			19.51			516.2		
	Control	1.83			0.33			18.28			563.6		
Rainy	SeriMore	1.86			0.35			18.64			538.8		
	Control	1.75			0.31			17.6			585		
		S	T	S x T	S	T	S x T	S	T	S x T	S	T	S x T
F -Test		*	*	NS	*	*	NS	*	*	NS	*	*	NS
SEm±		0	0	0.01	0	0	0	0.08	0.07	0.12	0.66	0.54	0.93
CD at 5%		0.01	0.01	NS	0.01	0.01	NS	0.24	0.2	NS	1.94	1.59	NS
CV (%)		0.76			1.71			1.24			0.34		

Table 4: Cocoon Weight, Shell Weight, SR% and No of Cocoons/kg in Different Seasons in Kolar District in Karnataka

Seasons (S)	Treatment (T)	Cocoon weight(g)			Shell weight (g)			SR%			No of cocoon/kg		
Summer	SeriMore	1.92			0.377			19.58			522.6		
	Control	1.83			0.335			18.28			567		
Winter	SeriMore	1.94			0.382			19.67			518		
	Control	1.83			0.335			18.3			566.4		
Rainy	SeriMore	1.85			0.347			18.75			546.6		
	Control	1.75			0.306			17.46			593		
		S	T	S x T	S	T	S x T	S	T	S x T	S	T	S x T
F -Test		*	*	NS	*	*	NS	*	*	NS	*	*	NS
SEm±		0.01	0.01	0.01	0.01	0.01	0.01	0.06	0.05	0.08	1.29	1.05	1.82
CD at 5%		0.03	0.02	NS	0.02	0.02	NS	0.17	0.14	NS	3.8	3.11	NS
CV (%)		1.33			1.57			0.85			0.66		

Table 5: Cocoon Weight, Shell Weight, SR% and No of Cocoons/kg in Different Seasons in Hindupur district in Andhra Pradesh

Seasons (S)	Treatment (T)	Cocoon weight (g)			Shell weight (g)			SR%			No of cocoon/kg		
Summer	SeriMore	1.92			0.368			19.21			525.6		
	Control	1.81			0.332			18.33			567.4		
Winter	SeriMore	1.94			0.373			19.27			521.6		
	Control	1.83			0.338			18.43			565.6		
Rainy	SeriMore	1.85			0.342			18.47			534.2		
	Control	1.75			0.303			17.31			591.6		
		S	T	S x T	S	T	S x T	S	T	S x	S	T	S x T

									T			
F -Test	*	*	NS	*	*	NS	*	*	NS	*	*	NS
SEm±	0.01	0.01	0.01	0.01	0.01	0.01	0.08	0.07	0.12	1.3	1.06	1.83
CD at 5%	0.02	0.02	NS	0.02	0.02	NS	0.24	0.2	NS	3.83	3.12	5.41
CV (%)	1.08			1.41			1.27			0.67		

In addition, it was found that cocoon yield increased by 12-16% in comparison to control batches (Table 2). It was found that the cocoon price increased (Rs.8-10 per kg) in all the batches of different district compared to the control batches. The net increase in profit in SeriMore treated batches were Rs. 1835 – 2500 per 100 dfls. It w as observed that cocoon weight, shell weight, and SR% were more in winter seasons than summer and rainy seasons (Table 1,2,3,4 and5).

Literature survey revealed that most of (JH) mimics applied on the silkworms were synthetic (Gangwar 2009; Nair *et al* 2002; Nair *et al* 2010; Nagendraradhya and Jagadeesh 2013; Trivedy *et al*., 1993 and Trivedy *et al* 1997) and it was tested on pure races like CSR2, MG408 and hybrids like KA x NB4D2, PM x NB4D2, CSR2 x MG408 and CSR4 x MU852. It was also observed that most of the studies are in lab scale. Nair *et al* (2012) studied the improvement in cocoon yield induced by a synthetic Juvenile Hormone Analogue, SB-515 in the Bivoltine Silkworm (*Bombyx mori* L.) hybrid, CSR2 x CSR4 and its reciprocal combination (CSR4 x CSR2) in large scale. Another large-scale trial was done by Brindha *et al* (2012) to study the effect of JH mimic on enhanced silk production in *Bombyx mori*. There is no large scale trial done (on PM x CSR2) or published so far on bakuchiol based formulations, an interesting work in laboratory scale by Nair *et al* (2010) showed a lot of positive effects. They studied the effect of diluted bakuchiol on the economic traits of the silkworm, *B. mori* L. The results showed that when bakuchiol was administered to the fifth instar silkworm hybrid KA x NB4D2, the highest increase in cocoon yield (5.74% compared to untreated control) was observed when treated at 48 hours. Further, the data from this work indicates a net increase of cocoon weight at 11.82%, increase of shell weight 14.54%, and an increase of shell ratio by 2.51%. From the present study, where in we have used bakuchiol along with other key nutrients and synergistic factors required for silkworm growth, it is clear that SeriMore administered at 48 h of 5th instar of silkworm hybrid (PM x CSR2) showed similar significant response as discussed earlier. In fact, percentage cocoon yield registered is 14% compared with reference to untreated control against that of 5.74% in only bakuchiol treated experiment. Further, in our present study, the values for a net increase of cocoon weight, an increase of shell weight and an increase of shell ratio in comparison to untreated controls are 5-8%, 13-17% %, and 5-8% respectively. An interesting point to note here is that the net improvement in shell ratio of 5-8% in case of SeriMore compared to 2.15% in case of bakuchiol as per Nair et al (2010).

These data suggest that the response of silkworm in terms of improvement in economic traits varies with the compounds used, silkworm races and geographical region. It is reported that the effect of JH mimics is governed by the dose and time of application (Akai *et al*., 1985, Trivedy *et al*., 1993). When cocoon and/or cocoon shell weight was improved, a corresponding but less prominent improvement in larval weight also was noticed. The improvement in the larval weight may not be a prerequisite for higher silk content (Nair *et al*., 2002). In fact increase in coccon yield and weight has fetched impressive profit to farmers as indicated in all the trials done using SeriMore in both the commercial breeds. In addition, reelers have reported better filament length in cocoon originated from SeriMore treatment.

4. CONCLUSION

It is concluded that the SeriMore can be used in sericulture for yield improvement as it can induce a stimulatory effect on protein synthesis in silk gland in silkworm. On large scale studied it has become clear that 0.1 µl/silkworm larvae administered at 48hrs of 5^{th} instar elicited a favourable response in silkworm in significantly improving the cocoon yield up to 12-16%, cocoon shell weight 13-17%. The results in present investigation clearly pointed out that SeriMore with bio active components (bakuchiol, nutritional ingredients, and synergistic factors) can enhance the cocoon yield which can be exploited not only to maximize the profits of sericulturists but also to improve the quality.

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