Uttar Pradesh J. Zool. 36(1) : 01-07, 2016 ISSN 0256-971X

A CRITICAL ANALYSIS ON SILKWORM REARING IN APRIL CROP AT WEST BENGAL

KUNAL SARKAR AND MAHASANKAR MAJUMDAR
POST GRADUATE DEPARTMENT OF SERICULTURE,
KRISHNATH COLLEGE, BERHAMPORE-742 101, INDIA
(e-mail : kunal1sarkar@gmail.com)

The present study clearly indicates that silkworm larvae were reared by adopting some low cost methods in combined in a separate rearing room like advocating Box rearing method in chawki stages, preparation and moistened of sand bed periodically by water, fixing of wet gunny cloth in the windows of the rearing room and moistened periodically by water, using of wet foam pad along with paraffin paper even upto fourth instar and using of wrap up method of rearing during chawki stages, hanging of wet gunny cloth in front of rearing racks and adaptation of shoot rearing in late stages clearly improves all essential qualitative and quantitative characters of silkworm breed reared in this season.

Key words : Silkworm, Rearing, April crop, West Bengal.

INTRODUCTION

India is the second largest silk producing country next to china, contributing about 15% of total silk output. In India there are 5 traditional sericulture states including West Bengal where Murshidabad is a traditional silk producing district that contributes maximum silk. Mulberry silkworm have been domesticated and reared under optimum conditions with care as required for its normal and healthy development.

In West Bengal rearing season is divided mainly in two parts *i.e.* favourable season and unfavourable season. November to April comes under favourable season and May to October comes under unfavourable season. During favourable season, generally dry summer is predominant and during unfavourable season wet summer is predominant. Mulberry crop span is 70 days. So five harvests as well as five rearings can be done in a year. November crop (winter / Agrahani), February crop (spring / Falguni) and April crop (summer / Baishaki) come under favourable season (dry summer) where as June-July crop (Rainy / Shrabani) and August-September crop (autumn / Aswina) come under unfavourable season (wet summer) (Das *et al.*, 1994 & 2006). Due to prevailing of comparatively less temperature and less humidity, it is comparatively easier to rear crossbreed (M×Bi) during favourable season. Because crossbreeds with bivoltine components can not with stand high temperature and high humidity (Das *et al.*, 1994, 2006).

During favourable season particularly in November and February comparatively less temperature and less humidity are prevailing in West Bengal. On the other hand during wet summer (unfavourable season) due to prevailing of high temperature, high humidity and heavy fluctuation of climatic condition it is better to rear multivoltine and their hybrids. Because multivoltine and their hybrids are more resistant to high temperature and high humidity as compare to crossbreeds (M×Bi) (Krishnaswami, 1978; Benchamin & Jolly, 1986). So at present in West Bengal multivoltine hybrid (N×M12 W) is

generally reared during unfavourable season and crossbreed (N×NB4D2) is generally reared during favourable season at farmers level (Das *et al.*, 1994 & 2006; Chattopadhyay *et al.*, 2004; Sarkar, 2006; Chattopadhyay & Sarkar, 2006 & 2008; Sarkar, 2009; Sarkar *et al.*, 2008). Though Sarkar & Moorthy (2012) suggested the suitability of Nistari×(SK6×SK7) for unvavourable seasons and rising bivoltine parents during unfavourable seed crop seasons. Sarkar (2014) again suggested the emerging of Nistari×(SK6×SK7) as rearing material at farmers' level instead of (N×NB4D2).

But rearing in April crop is not easier in West Bengal because prevailing of comparatively high temperature in the environment. Particularly during the 5th instar very high temperature is experienced by Sericulturists in West Bengal which is highly detrimental for silkworm larvae. Because silkworm larvae of 5th instar usually prefer comparatively lower temperature (24-25^{0}C). But in later part of April crop we usually experience almost 40^{0}C in West Bengal. Even humidity also becomes lower some times. Here an effort has been done to minimize the effect of high temperature particularly in 5th instar and low humidity in chawki stages in case of April crop.

MATERIALS AND METHODS

The present investigation was carried out during 2015 at April crop at the Dept. of Sericulture, Krishnath College, Berhampore (latitude 24°50′N and longitude 88°13′E), Murshidabad, West Bengal, India with the aim to minimize the effect of high temperature particularly in 5th instar and low humidity in chawki stages in case of April crop.

Meteorological Condition : Average temperature & humidity recorded during silkworm rearing in April (summer / Baishaki) crop was 40.4^{0}C & 71.12% (at normal)

Experimental race : Nistari× (Sk6×Sk7)

Rearing Procedure : This race which was used as experimental material were reared by feeding S_{1635} mulberry leaves maintained under irrigated condition. Four feeding schedule (6 a.m., 11 a.m., 4 p.m. and 9 p.m.) was followed in a day.

Experimental Design : Here silkworm larvae were divided into two groups and each group was having three replicates for each replicate 300 larvae were maintained by giving following condition.(Two separate rearing room is taken for two different treatments)

Treatment I

Silkworm larvae were reared in natural condition

Treatment II

Silkworm larvae were reared by adopting some low cost methods in combined in a separate rearing room. Among low cost methods, followings are adopted

- Box rearing is advocated during the chawki stages.
- Sand bed is prepared in the rearing house and moistened periodically by water
- Fixing of wet gunny cloth in the windows of the rearing room and moistened periodically by water
- Using of wet foam pad along with paraffin paper even upto fourth instar and using of wrap up method of rearing during chawki stages.
- Hanging of wet gunny cloth in front of rearing racks adaptation of shoot rearing in late stages.

After completion of the rearing and mounting operation the cocoons were harvested on sixth day and the parameters such as larval duration, larval weight, effective rate of rearing, single cocoon weight, single shell weight, shall ratio , melting percentage and cocoon yield were recorded, subsequently the cocoons were subjected to reeling operation and the following parameters like average filament length, non-breakable filament length, denier, renditta, reelability percentage and raw silk recovery percentage were recorded.

Besides that Moisture retention capacity of mulberry leaves in both the treatments are calculated after 6 hours was calculated by using the formula :

$$MRC = \frac{\text{(Wt. of leaves after 6 hour-leaf dry weight)}}{\text{(Leaf fresh weight- Leaf dry weight)}} \times 100$$

Following standard formulae are used to calculate various parameters :

1. $SR\ \% = \frac{\text{Shell Weight}}{\text{Green Cocoon Wt.}} \times 100$

2. $\text{Non breakable filament length} = \frac{\text{Total Filament length}}{\text{Number of cocoons} + \text{no. of breaks}}$

3. $\text{Denier} = \frac{\text{Weight of silk filament in gm.}}{\text{Length in meter}} \times 9000$

4. $\text{Reelability \%} = \frac{\text{No of good cocoon fed}}{\text{No of casting}} \times 100$

5. $\text{Recovery \%} = \frac{\text{Silk Weight (gm)}}{\text{Silk wt (gm)} + \text{Silk waste wt (gm)}} \times 100$

6. $\text{Renditta} = \frac{\text{Green cocoon wt}}{\text{Silk weight}}$

7. $\text{Melting \%} = \frac{\text{Number of melted cocoons}}{\text{Total no of Cocoons}} \times 100$

8. $\text{Effective Rate of Rearing (ERR)} = \frac{\text{Total number of cocoon harvested} \times 10000}{\text{Total number of larvae brushed or counted after III}^{rd}\ \text{moult}}$

RESULTS AND DISCUSSION

Treatment II showed best performance in terms of average filament length (741.348 meter), non breakable filament length (614.05 meter), denier (2.1), renditta (8.501kg), raw silk recovery percentage (66.959%) and reelability percentage (75.228%) respectively (Table I).

Cocoon yield (50.276 kg/100DFLs), single cocoon weight (1.42 gm), single shell weight (0.3219 gm), SR% (18.18%) and larval weight (49.946 gm for 10 larvae) were

also higher in case of Treatment II batch. Effective Rate of Rearing of Treatment II (8212.5) was higher than Treatment I batch (8081.8). Larval duration in Vth instar is comparatively lower in Treatment I batch (137.2 hours) as compared to Treatment II batch (140 hours) (Table I).

Treatment I during April crop showed comparatively inferior results than Treatment II in terms of average filament length (643.94 meter), non breakable filament length (535.039 meter), denier (2.043), renditta (9.079kg), raw silk recovery percentage (66.225%) and reelability percentage (74.751%), respectively (Table II).

Cocoon yield (46.679 kg/100DFLs), single cocoon weight (1.342 gm), single shell weight (0.2618 gm), SR% (16.984%) and larval weight (45.999 gm for 10 larvae) were also less in Treatment I than Treatment II batch. Effective Rate of Rearing of Treatment I (8063.6) was comparatively lower than Treatment II batch (8212.5) (Table II).

In the month of April moisture retention capacity of mulberry leaf is an important parameter. Present experiment has showed that moisture retention capacity of different maturity level of mulberry leaves showed better performance in treatment II where various efforts are done to reduce temperature in the rearing room as well as in rearing bed (Table III).

In April crop, high temperature creates problems particularly in late instars. Besides that low humidity also creates problems particularly in early instars. So the main challenges in the rearing of April crop are to maintain optimum temperature and humidity in the rearing room. Present experiment has showed that in Treatment II where various convenient measures are taken help to increase humidity in the rearing bed as well as help to maintain moisture in the rearing bed.

Advocating of Box rearing method during chawki rearing

This method is practiced when humidity are lower than optimum. During the eating period trays are arranged one above the other upto a convenient height on a chawki rearing stand like a box. Arranging of the trays in this method can increase the humidity of the rearing bed. Thirty minutes before the feeding and during the moulting period paraffin paper cover and old news papers are removed and the trays are arranged in a Kris cross pattern for allowing the rearing bed to dry. This method is ideal for chawki rearing centers as minimum space is required for large rearing.

Using of wet foam pad along with paraffin paper even upto fourth instar and using of wrap up method of rearing during chawki stages

Using of wet foam pads and paraffin paper help to increase humidity in the rearing bed. In this experiment in chawki stages an alternate method of rearing without using foam pad is advocated which is named as wrap up method of rearing. Here all the four sides of the rearing bed are folded with a paraffin paper. This method is done only in first two instars because chawki worms can resist bad ventilation. In case of early instar larva (1^{st}, 2^{nd} and 3^{rd} instar) consumption of leaf is only 6% and ingestion percentage is also very less (25% ingestion in 1^{st} instar, 40% ingestion in 2^{nd} instar and 50% ingestion in 3^{rd} instar). Due to less consumption and less ingestion percentage of leaf, enzymatic activity is also less during metabolic activity. Due to less metabolic activity generation of Carbon

Table I : Performance of Treatment-I and Treatment-II on reeling character on April crop.

Treatment	Average Filament Length (m)	Non Breakable Filament Length (m)	Denier	Renditta (Kg.)	Raw Silk Recovery Percentage	Reelability Percentage
I	643.94	535.09	2.043	9.079	66.225	74.751
II	741.348	614.05	2.1	8.501	66.959	75.228
CV%	0.8294	0.8850	0.9662	0.4044	0.0788	0.0796
SE±	1.8788	0.0079	0.0010	0.0124	0.01329	0.026
CD at 5%	4.7173	4.1927	0.0176	0.0328	0.0468	0.0533
Significance level	**	**	**	**	**	**

**: Significant

Table II : Performance of Treatment-I and Treatment-II on yield and cocoon character on April crop.

Treatment	10full grown larval weight (gm)	Larval duration (hrs in Vth instar)	E.R.R by num-ber (10000 larvae)	Single cocoon Wt (gm)	Single Shell Weight (gm)	SR%	Yield (kg/100 DFLs)	Melting (%)
Treatment - I	45.999	138.4	8063.6	1.342	0.2618	16.984	46.679	5.184
Treatment - II	49.946	140.0	8212.5	1.42	0.3219	18.18	50.276	4.785
CV%	0.1080	1.5856	0.0841	1.567	1.0902	0.2344	0.4852	0.0914
SE±	1.1809	1.4026	0.0060	0.021	0.044	0.0276	0.0204	0.7605
CD at 5%	0.0458	1.9944	6.0383	0.022	0.0026	0.0361	0.0264	0.0379
Significance level	**	**	**	**	**	**	**	**

** : Significant

Table III : Moisture retention capacity of mulberry leaf after 6 hours.

Treatment	Moisture Retention Capacity of mulberry leaf after six hours
Tr -1	Tender leaf-78.34%, Medium leaf-75.32%, Mature leaf-73.08%
Tr -2	Tender leaf-80.05%, Medium leaf-77.82%, Mature leaf-74.02%

dioxide and temp is less, so early instar silkworm can be reared in comparatively high temperature and less ventilated condition than late age silkworms (Sarkar *et al.*, 2008 & 2012). On the other hand early instar larva comparatively requires more moisture because 1st two stages are considered as water accumulation stage and during late instar silkworm starts to release water (Ueda, 1982). By adopting wrap up method of rearing humidity range is increased by 20%-30%.

Advocating of various methods to reduce temperature during late age rearing

In case of late age silkworms due to more consumption of leaf (Approximately 14% leaf in 4th instar and 80% leaf in 5th instar) and due to more ingestion percentage,

enzymatic activity is more which ultimately induces more generation of temperature so it is important to provide comparatively less temperature in late instar. So various methods can be advocated to reduce temperature in the rearing room like Sand bed is prepared in the rearing house and moistened periodically by water, Fixing of wet gunny cloth in the windows of the rearing room and moistened periodically by water, using of wet foam pad along with paraffin paper even upto fourth instar and hanging of wet gunny cloth in front of rearing racks. These methods usually increase the humidity in the rearing bed. But it is estimated that increasing of 4% relative humidity can decrease 1°C of temperature. Though late instars are susceptible to high humidity but in dry summer increase in humidity in late instars may helpful in silkworm rearing and the only way to reduce temperature in the rearing room (Sarkar *et al.*, 2008 & 2012).

Advocating of Shoot rearing method

Shoot feeding is always beneficial than individual leaf feeding particularly in latter stage. In case of individual leaf feeding, particularly in latter stages when silkworms become much bigger try to crawl on individual leaves for feeding and leaves virtually go lower side due to pressure of silkworm and silkworm cannot fully utilize the leaves. It has also been observed that feeding silkworm with shoot in late stage has many advantages. It can save labour, time, leaf, number of bed cleaning and rearing space in late stage. Mathur (1997) suggested that a total of 27 man days can be saved for 100 DFLs rearing and approximately 54.86% cost on cocoon production can be reduced by adopting shoot feeding method. In case of shoot feeding silkworm larvae crawl on shoot one above another and in this way they can get rid from diseased larvae, litter, waste leaves etc. In this way shoot rearing also helps to maintain hygienic condition in the rearing bed.So it is important to adopt shoot rearing technique at farmers level in West Bengal. For proper conducting of shoot rearing it is important to adopt three tiers system of shoot rearing at farmers' level. Chattopadhyay *et al.* (2004) suggested that proper concept of shoot rearing is completely absent at farmers level in the three traditional district.

ACKNOWLEDGEMENT

Grateful thanks are due to Dr. Sanat Kumar Ray, Associate Professor and Head, Post Graduate Department of Sericulture, Krishnath College, Berhampore, (W.B.) for providing necessary facilities.

REFERENCES

BENCHAMIN, K.V. & JOLLY, M.S. 1986. *Principles of silkworm rearing.* In Proceeding of Seminar on Problems and Prospects of Sericulture (Mahalingam, S. (Ed.). pp. 63-108. Vellore, India.

CHATTOPADHYAY, S.K., SARKAR, K. & BHATTACHARYA, D. 2004. Key Points behind the Success of Cocoon Crops at Farmers Level in West Bengal. Dissertation submitted to the University of Kalyani for the partial fulfillment of Master of Science in Sericulture.

CHATTOPADHYAY, S.K. & SARKAR, K. 2006. Published and Printed by Aakaash Publications. Berhampore, West Bengal.

CHATTOPADHYAY, S.K & SARKAR, K 2008. A Profile of Sericulture. *Journal of Environment and Sociobiology.* **5**(1) : 1-6.

DAS, S.K., PATTNAIK, S., GHOSH,B., SINGH,T., NAIR. B.P., SEN, S.K. & SUBBA RAO, G. 1994. Heterosis analysis in some three way crosses of Bombyx mori L., *Sericologia.* **34**(1) : 51-61.

DAS, S.K., CHATTOPADHYAY, G.K., MOORTHY, S.M., VERMA, A.K., GHOSH, B., RAO, P.R.T., SENGUPTA, A.K. & SARKAR, A. 2006. Silkworm Breeds and Hybrids for Eastern Region. In : *Appropriate Technology in Mulberry Sericulture for Eastern and North Eastern India* (17th and 18th January, 2006) workshop organized by C.S.R. & T.I., Berhampore : 91-96.

KRISHNASWAMI, S., AHSAN, M.M. & SRIHARAN, T.P. 1970 Studies on quality of mulberry leaves and silkworm cocoon production, Part-2. Quality difference due to maturity. *Indian J. Seric.* **9** : 11-17.

KRISHNASWAMI, S. 1978. *New technology of Silkworm rearing.* C.S.R. & T.I., Mysore. pp.1-10.

MATHUR, V.B. 1997. Shoot rearing to save cost. *The Indian Textile Journal.* 80.

RAY, G.L. & MONDAL, S. 1997. *Research Method in Social Science & Extension Education,* Naya Prakash, Calcutta.

SARKAR, A. 2006. Mulberry Sericulture in West Bengal. Power point representation.

SARKAR, K, BHATTACHARYA, D.K., CHATTOPADHYAY, S.K., TRIVEDI, S. & GHOSHAL, S. 2008. Effect of feeding of different maturity level of mulberry leaves on the commercial characteristics of *Bombyx mori* L. during dry summer in West Bengal. *Journal of Environment and Sociobiology.* **5**(1) : 7-18.

SARKAR, K., BHATTACHARYA, D.K., CHATTOPADHYAY, S.K., BAUR, G. & RAY, S.K. 2012. Effect of feeding of different maturity level of mulberry leaves on the commercial characteristics of *Bombyx mori* L. during late larval stage in dry summer. Proceedings of the UGC sponsored state level seminar on "Advancement of Biological Science towards Sustainable Development", 29 th & 30 th March. :142-154.

SARKAR, KUNAL. 2009. Reshamer Katha. *Suryabarta.* **4**(3) : 25-27.

SARKAR, K., BHATTACHARYA, D.K. & CHATTOPADHYAY, S.K. 2008. Performances of Multivoltine Hybrid Nistari×M12 (W) and Cross Breed N×NB4D2 of *Bombyx mori* L. during favourable and unfavourable season in West Bengal. *Journal of Environment and Sociobiology.* 5(1) : 37-41.

SARKAR, K. & MOORTHY, S.M. 2012. Evaluation of multivoltine based silkworm hybrids for rearing during unfavourable Seasons in West Bengal. *Journal of Sericulture & Technology.* **3(1)** : 64-66.

SARKAR, K. 2014. A critical analysis on status of rearing of different silkworm breeds at farmers' level of Nabagram block in Murshidabad district of West Bengal. *Journal of Environment and Sociobiology.* (In Press).

UEDA. SATORU. 1982. Theory of the growth of silkworm larvae and its application. *JARQ.* 15(3) : 180-184.

(Manuscript Received : February 2016)