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Impact of Integrated Chawki Rearing Technology on Cocoon Production of Muga Silkworm, *Antheraea assamensis* Helfer

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ABSTRACT: In muga culture, high mortality of larvae occurred particularly in the early stage of rearing to the tune of 15 to 25 %. The present paper examines the impact of adoption of integrated chawki (1st to 3rd instar larvae) rearing technology as a strategy for improving muga cocoon production in India. During Jethua Crop (May-June), the cocoon yield of the farmers who adopted the technology ranged from 4552 to 6178 per 100 disease free laying (dfl) while in the traditional lot, it ranged from 4020 to 5490 per 100 dfl. It was observed that increase in cocoon yield in the technology adopted lots over that of control lot ranged from 8.07 % to 17.02 %. Similarly, during *Kotia* crop (October-November), the cocoon yield of the farmers who adopted the technology ranged from 4367 to 6215 per 100 disease free laying (dfl) while in the control lot, it ranged from 3970 to 5624 per 100 dfl. During this crop, increase in cocoon yield of the treated lot over that of control ranged from 6.70 % to 18.62 %. Significant improvement in cocoon production was observed due to the adoption of the chawki rearing technology in muga culture.

Key words: *Antheraea assamensis* Helfer, chawki rearing technology.

INTRODUCTION

Sericulture is a labour oriented, low investment, agrarian small scale industry which suits both marginal and small land holders because of its high returns, short gestation period, and it creates opportunity for own family employment round the year. Sericulture serves as an important tool for rural reconstruction, benefiting the weaker sections of the society (Lakshmanan *et al.*, 1998). Muga culture like other forms of sericulture is an industry that is characterized by a three-step process, the cultivation of food plants- som (*Persea bombycina* Kost) and Soalu (*Litsea monopetala*) trees, the rearing of silkworms on these leaves to produce cocoons and the production of silk threads and fabrics. North east India- the indigenous home of muga silkworm, *Antheraea assamensis* Helfer has a long history in muga cocoon and silk production but muga silk productivity in the country is low due to lack of adoption of improved technologies. Lack of awareness of new technologies at the farmers' level has been one of the main lacunae in the development of this industry. Muga silkworm, *Antheraea assamensis* Helfer is a multivoltine insect. Muga silkworm completes 5-6 crop cycles in a year, of which, spring (May-June) and autumn (October-November) are considered as commercial crops and remaining four crops as pre-seed or seed crops. In the crop cycle, each commercial crop is preceded by one seed crop and each seed crop is preceded by one pre seed crop, as such, autumn commercial crop (October-November) is preceded by late summer seed crop (August-September) which is preceded by summer pre-seed crop (June-July). Due to outdoor nature of rearing high mortality larvae occurred particularly in the early stage of rearing to the tune of 15 to 25 %. Farmers adopted age old traditional technologies of host plant management and rearing technologies (Thangavellu *et al*., 1988; Sarmah *et al.*, 2010). A number of farmers' friendly new technologies have been innovated by the scientists of Central Muga Eri Research and Training Institute, Jorhat, Assam (India) which is boon for the development of muga industry. In order to enhance the muga silk production, to meet the future demands, adoption of new technologies at the farmers' field is needed. This study examines the impact of adoption of integrated chawki (1st to 3rd instar larvae) rearing technologies as a strategy for improving muga cocoon production in India.

MATERIALS AND METHODS

Five villages of Assam (India) were identified and 20 muga farmers were selected from each village for the present study. Each farmer was supplied 100 disease free layings (dfls) of muga silkworm and rearing was conducted in outdoor for two commercial crops on the foliages of Som, *Persea bombycina* Kost.

In each village, 10 farmers conducted rearing without adopting the chawki rearing technology (control) while 10 farmers adopted the integrated chawki rearing technology(treatment) as detailed as detailed below.

Pruning and defoliation: The main objective of this component is the proper management of the food plants to produce disease free nutritious leaves suitable for the young age silkworms and effective management during rearing. About 20% of the total plants were pruned to the height of 6-7 ft. before 4-5 months of rearing and remove the old leaves (Fig.1). Clean the base of the food plants and garden by cutting all unwanted weeds. Mixture of slaked lime and bleaching powder (9 : 1) was sprayed in the field on bright sunny days after cleaning to kill the disease germs available in the food plants as well as on the ground.

Application of manure and fertilizer: The main objective of this component is to produce nutritious leaves suitable for the chawki larvae. After pruning and defoliation, 2 cft of farm yard manure (FYM) was applied to each plant in two split doses.

When the plants attained 5 years, 80 g urea, 120 g phosphate and 30 g potash per year is applied per plant to produce quality foliage. Manure and fertilizer are applied by digging ring of 6"- 8" depth with a radius of 2 ft around the food plant and immediately the ring is filled up with soil.

Fig. 1. Pruning of Som to get quality leave.

Fig. 2. Good quality foliage of Som after pruning.

Fig. 3. Brushing of larvae under nylon net.

Fig. 4. Good harvest after adopting technology.

Pre-brushing care and management:

(i) *Incubation of eggs before brushing:*
Hatching of muga eggs also depends upon the care taken incubation/preservation. Eggs were incubated at 25-26°C and 80-85 % relative humidity. However, if incubation facility is not available in farmer's field, eggs were preserved in single layer in bamboo tray in well aerated and disinfected thatch house where normally temperature remains at 26 °C- 28 °C. Before 2 days of hatching, eggs were transferred to small paper packets @2 g per packet for convenience of brushing. Before one day of hatching, 2/3 tender food plant leaves were put inside the egg packet in the evening time so that in the following morning just after hatching tiny larvae may crawl over the leaves and eat the leave.
(ii) *Selection of plant for brushing:* In the already prepared chawki rearing plot, all plants will be ready for brushing with semi tender nutritious foliage (Fig. 2). For winter season, brushing plants were selected towards sunlight and for summer plants were selected opposite to the direct sunlight.
(iii) *Pre-brushing care of plants:* The plants were covered with nylon nets before one day of brushing to protect the chawki larvae from pest and predators (Fig. 3). The selected plants were disinfected by spraying 0.02 % sodium hypo chloride solution before 2 days of brushing. The rearing was conducted fully under nylon net cover till 3rd instar. After brushing all used food plans were wrapped with polythene sheet or banana leaf as a barrier on the tree trunk above 1.5 – 2 ft from the ground to obstruct the geo-negative movement of the larvae up to the ground.
(iv) *Care during rearing:* The newly larvae were reared in outdoor condition on the foliages of som. 0.01% sodium hypo chloride solution was sprayed in the foliages along with the worms once in each instar to protect the larvae from bacterial and viral attack. During rainy day, slaked lime was dusted in the chawki plot with full care so that lime powder may not come in contact with the muga larvae.
After completion of the rearing, data of cocoon harvest were collected from the farmers and compared with the control lots.

RESULTS AND DISCUSSION

The cocoon production data for two commercial crops are shown in table 1 and table 2. During *Jethua* Crop (May-June), the cocoon yield in the treated lot ranged from 4552 to 6178 per 100 disease free laying (dfl) while in the control lot, it ranged from 4020 to 5490 per 100 dfl. It was observed that increase in cocoon yield of the treated lots over that of control lots ranged from 8.07 % to 17.02 %. Similarly, during Kotia crop (October-November), the cocoon yield in the treated lot ranged from 4367 to 6215 per 100 (dfl) while in the control lot, it ranged from 3970 to 5624 per 100 dfl. During this crop, increase in cocoon yield of the treated lots over that of control lots ranged from 6.70 % to 18.62 %. The cocoon production data before the adoption of technology and after the adoption of technology were subjected to Student's "t" test and compare with the table value. It is clear from Table 1 and 2 that the calculated "t" values of the cocoon production of the ten farmers in each village were significantly higher than the table value during these two crops which evinced that the adoption of the technology significantly increased cocoon production.

The increase in cocoon yield is due to the increase in the nutritional quality of the leaves after adoption of the technology. The production of good cocoon crop is totally dependent on the quality of leaves and maintenance of hygienic condition in rearing field. In *Bombyx mori*, the nutritional elements of mulberry leave determine the growth and development of the larvae and cocoon production (Nagaraju, 2002; Sridavi *et al*., 2005). The quality of the leaves has a profound effect on the superiority of silk produced. Leaves of superior quality enhance the chances of good cocoon crop (Ravikumar, 1988). It has also been demonstrated that the dietary nutritional management has a direct influence on quality and quantity of silk production in *B. mori* (Murugan *et al.*, 1998). Adoption of improved technologies of rearing and food plant management increased cocoon production (Priyadarshini and Kumari, 2013).

Disinfection and maintenance of hygienic condition during rearing are essential factors for preventing occurrence of diseases. Sodium hypochlorite acts as a leave surface disinfectant. Sodium hypochlorite is effective against bacteria, viruses and fungi and it disinfects the same way as chlorine does. When sodium hypochlorite dissolves in water, two substances *viz*., hypochlorous (HOCl) and the less active hypochlorite ion (OCl^-) are formed, which play a role for oxidation and disinfection. The efficacy of Sodium hypochlorite in controlling mortality due to bacterial and viral diseases has been reported in tasar and muga silkworms (Sahay e*t al.*, 2008; Singh *et al*., 2014). The application of sodium hypochlorite solution to the foliages before the rearing and during the rearing reduces the mortality due to bacterial and viral diseases thereby contributing in increasing the cocoon productivity.

The result of the present study shows that the integrated "chawki rearing technology" is effective in increasing the cocoon production and therefore this technology should be percolated to all the muga farmers for increasing the cocoon production. The extension activities should be taken up in such a way that the farmers should get convinced about the benefits of following improved techniques.

Table 1 : Cocoon production at farmers, field during Jethua crop per 100 dfl.

Village	Control / Treatment	Farmers										"t" value
		1	2	3	4	5	6	7	8	9	10	
Sonowal	**Control**	4880	5221	4975	4789	4120	4800	4525	4879	4112	5334	3.945
	Treatment	5423	5854	5532	5433	4615	5424	5068	5482	4605	5854	
	Improvement(%) over control	11.12	12.12	11.19	13.44	12.01	13.00	12.00	12.36	12.00	9.75	
Tamulbari	**Control**	4221	3989	4570	5120	5030	4780	4760	4367	4967	4970	3.106
	Treatment	4812	4587	5105	5656	5635	5423	5474	4892	5464	5645	
	Improvement(%) over control	14.00	14.99	11.70	10.46	12.02	11.85	15.00	12.02	10.00	13.58	
Thaura	**Control**	4020	4330	3890	4480	4987	4690	4380	5080	4890	5221	5.424
	Treatment	4583	4893	4552	5018	5665	5244	4906	5651	5513	5728	
	Improvement(%) over control	14.99	13.00	17.02	12.00	13.59	11.81	12.01	11.20	12.74	9.71	
Duwarisinga	**Control**	4500	4220	4980	4338	4898	5110	4976	5078	4990	4280	6.508
	Treatment	4950	4853	5617	4816	5444	5603	5872	5927	5709	4708	
	Improvement(%) over control	10.00	15.00	12.79	11.02	11.14	9.64	18.00	16.72	14.40	10.00	
Humhumia	**Control**	4400	5278	4980	5623	5190	5080	4978	5490	5056	5012	3.853
	Treatment	4840	5801	5778	6178	5609	5570	5795	6170	5862	5453	
	Improvement(%) over control	10.00	9.91	16.02	9.87	8.07	9.64	16.41	12.38	15.94	8.40	

***Table value of "t" at 5% = 1.83, and at 1% = 2.82**

Table 2: Cocoon production at farmers, field during Kotia crop per 100 dfl.

Village	Control / Treatment	Farmers										"t" value
		1	2	3	4	5	6	7	8	9	10	
Sonowal	**Control**	5200	4980	3970	5200	4879	5012	4689	5020	5345	4978	4.880
	Treatment	5624	5478	4367	5720	5513	5432	5345	5522	5729	5326	
	Improvement(%) over control	8.15	10.00	10.00	10.00	12.99	11.03	13.99	10.00	6.70	6.99	
Tamulbari	**Control**	4500	5230	4980	4565	3988	5023	4980	4890	5010	4990	4.882
	Treatment	5530	5892	5478	5250	4546	5675	5678	5628	5411	5688	
	Improvement(%) over control	18.62	12.65	10.00	15.00	13.98	12.98	14.01	15.09	8.00	13.98	
Thaura	**Control**	4565	4780	5020	4980	4565	5120	5070	4880	4050	4289	4.045
	Treatment	5113	5354	5372	5478	5022	5478	5476	5624	4455	4632	
	Improvement(%) over control	12.00	12.01	7.01	10.00	10.01	7.00	8.00	15.24	10.00	8.00	
Duwarisinga	**Control**	5010	4560	4980	5030	5470	4720	4868	5230	5260	4980	3.400
	Treatment	5510	5198	5577	5382	5944	5286	5524	5865	5628	5828	
	Improvement(%) over control	10.00	13.99	11.98	7.00	8.66	11.99	13.47	12.14	7.00	17.02	
Humhumia	**Control**	4880	5490	4536	5130	5090	4878	4560	5120	4878	5467	5.870
	Treatment	5515	5965	5080	5892	5697	5415	5016	5776	5602	6215	
	Improvement(%) over control	11.51	8.47	11.99	14.85	11.90	11.00	10.00	12.81	14.84	13.68	

***Table value of "t" at 5% = 1.83, and at 1% = 2.8**

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