Study on Comparative Reeling Performance of Multi-end Reeling Machine and Cottage Basin Reeling Machine for Qualitative and Quantitative Improvement of Raw Silk Production

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ABSTRACT

A multi-end reeling machine with re-reeling unit has been fabricated at BSRTI for production of raw silk with high quality and quantity. The experiment was done by thirty samples of green cocoons in four different seasons to determine the cocoon characteristics and reeling performances on multi-end reeling machine. Mean renditta, raw silk recovery %, reelability %, waste % were found 11.01, 69.80%, 63.24% and 24.26%. It was also found that mean tenacity and elongation percentage were 3.10 (g/d) and 18.70% in multi-end reeling machine, whereas it was 2.83 (g/d) and 18.61% in cottage basin respectively. BSRTI fabricated multi-end reeling machine was suggested as an improved reeling appliances commercially to get high quality raw silk production.

Introduction

In Bangladesh cocoon reeling is practiced in kathghai and cottage reeling machine without controlling quality of raw silk. As a result the silk produced by the reeler can not be used as warp in weaving fabric. In spite of development of improved methods and reeling techniques most of the reelers are still following traditional reeling methods. Reeling of cocoons in cottage machine and traditional charka will not ensure quality silk production. The performance of silk reeling and quality raw silk production mainly depends on cocoon quality, reeling device and process of reeler's skillness and quality control (Sonowalker *et al.1990*, Shreshail *et al.1995*, Subhas *et al.1994*, Halliyal *et al.1999* and Qader *et al. 2004*). The quality of raw silk produced in cottage basin was better than that of silk produced from katghai/charkha/thai reeling machine but yet it could not meet the international standards. Hariraj *et al (1992)* reported that in India raw silk produced in cottage and domestic basin was better than the silk of charkha production but this raw silk could not meet the standard of International market.

Sonwalkar *et al. (1981)* reported that multi-end reeling machine is a modern device in India and China and using for reeling bivoltine cocoons for better quality raw silk production. But in Bangladesh, weather is superior to multivoltine cocoon production which are lower in yield, poor productivity and shows many variations in cocoon sizes that influences reeling performance and silk quality. Bangladesh Sericulture Research and Training Institute (BSRTI) fabricated a 4 (four) basin multi-end reeling machine with re-reeling unit with standard mechanism to overcome this problems. For casting new end of cocoon filament during reeling is generally practiced by hand but in new machine Z-bow is introduced for automatic casting.

Due to this Z-bow, size of silk can be control for easy and timely casting of new filament which is suitable to produce quality raw silk from commercially available hybrid/bivoltine cocoon.

Materials and Methods

The Multi-end reeling machine (four basin) with re-reeling unit has been fabricated that shown in (Fig 1). The main frame of the machine is set on the platform made by bricks that jacketed with ceramic tails for lucrative as well as to protect vibration during reeling.
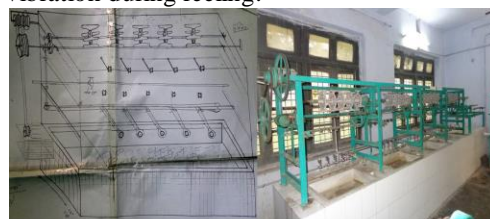
Fig 1. Multi-end reeling machine with re-reeling unit.

Body frame and basement of machine:

The structural design of the reeling machine is made of mild Iron angle and steel so the machine helps to smooth run. The frame is set on the platform made of breaks and jacking with ceramic tiles to prevent the machine from jerking and vibration during reeling. A re-reeling unit has been incorporated with main frame for easy re-reeling during reeling time together.

Reeling basin

The reeling basin is made of aluminum with an optimum dimension of $62 \times 44 \times 12$ cm accommodate with five reeling ends. Total number of five reelers can use twenty reeling ends at a time with four basins.

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The basin has been set in the machine with removable facilities so that it can easily remove as and when needed. The reelers may sit or stand during reeling in front of the brsin.

Jette boute

Jette boute is made of high density plastic with brass hollow pin for long durability and provided efficient mechanisms. It is located at the height of 18 cm above the reeling water level. An endless spring wire drives Jette boute to rotate easily at high speed.

Porcelain buttons

Porcelain buttons with appropriate holes are used in the machine and fixed to the still clip holders, which are 8 cm height from the jette boute rail with 2.0 gm weight each.

Croissure pulley

A tavellette' type of croissure is maintained by means of croissure pulleys to facilitate smoother thread movement during reeling and also to maintain appropriate tension level. It's weight is 18 gm each. The distance between the top and bottom croissure pulley is about 13 cm and first pulley to porcelain buttons is about 8 cm at the height of 4 cm above the buttons.

Traverse mechanism

A planetary traverse system is incorporated for suitable distribution of thread on the reel with cam and gear arrangements. The weight of the traverse guide is 4.0 gm and length of traverse bar is 376 cm.

Reel:

High quality small aluminum reels with smooth surface has been used. The circumference of reels is 65 cm weighing about 640 gm.

Experimental works

The reeling performance and quality raw silk was produced in the laboratory by using multi voltine hybrid cocoons used multi-end reeling machine and traditional cottage basin. The fabricated multi-end reeling machine was installed at BSRTI lab.

The experiment was done by thirty samples (containing 1kg each) of green cocoons collected from silkworm section in four different seasons to determine the cocoon characteristics and reeling performances on multi-end reeling machine. The study was conducted in four different silkworm rearing seasons viz. Chaita, Jaishta, Bhaduri and Agrahyani 2013-14 designated as S_1, S_2, S_3 and S_4 seasons respectively. The collected cocoon samples were dried in a hot air dryer following the methods of subhas *et al. (1994)*. After drying, cocoon samples were stored in storage racks for two days before reeling (Sonwalkar *et al. 1990*). Fifty cocoons from each sample were reeled for single cocoon filament length, non-breakable filament and denier test in every season.

The cocoon characteristics and reeling performances like defective cocoon (DFC)%, single cocoon weight (SCW), single shell weight (SSW), raw silk %, raw silk recovery %, reelability %, filament length (FL), non-breakable filament (NBFL), single filament denier (SFD) and renditta were determined according to Sonwalkar (1988) and Shamachary (1986). The raw silk produced from the study was tested for different quality parameters as per standard methods.

Result and Discussion

The data on cocoon characteristics are shown in Table 1. It may be observed from the Table that the mean single cocoon weight, single shell weight and shell ratio were 1.40g, 0.24g and 16.25% respectively. It was also found that mean filament length, non-breakable filament length and single cocoon filament denier were 584.33m, 373.17m and 2.74 respectively. The defective cocoon percentage was obtained 7.78% on the basis of total number of cocoons. All parameters shows highly significant (P<0.01). From the results it is seen that all parameters studied in the laboratory and in different seasons varied due to variations of cocoon sizes. Sonwalkar *et al. (1990)*, Hariraj *et al. (1992)* and Subhas *et al. (1994)* were reported similar results.

Table 1. Characteristics of cocoon.

Parameters		SCW	SW	SR	FL	NBFL	SCFD	DFC
Location	Season	(g)	(g)	%	(m)	(m)		%
BSRTI lab Rajshahi	S_1	1.43	0.23	15.51	581.67	372.00	2.67	8.11
	S_2	1.32	0.22	16.32	569.00	342.67	2.71	7.25
	S_3	1.36	0.23	16.34	573.67	345.00	2.78	7.72
	S_4	1.50	0.27	16.82	613.00	433.00	2.82	8.07
Mean±SD		1.40±0.07	0.24±0.02	16.25±0.49	584.33±18.05	373.17±38.09	2.74±0.07	7.78±0.39
LS		**	**	**	**	**	**	**

**significant at P<0.01, NS=Not significant

SCW=Single Cocoon Weight, SW=Shell Weight, SR=Shell Ratio, FL=Filament Length, NBFL=Non Breakable Filament Length, SCFD=Single Cocoon Filament Denier, DFC=Defective cocoon.

Table 2 represents the reeling performance of cocoons on Multi-end reeling machine and cottage basin respectively. From the reeling results mean renditta, raw silk recovery %, reelability %, waste % were found 11.01, 69.80%, 63.24% and 24.26% in multi-end reeling machine but in cottage basin it was obtained 11.95, 67.94%, 65.28%, 25.70% respectively which varied between seasons due to cocoon quality. In this table for multi-end reeling machine, all of the parameters except Raw silk production/8 hrs/10 ends, and Average quantity of cocoons used/day/basin shows highly significant at P<0.01 also for cottage basin reeling machine all parameters shows same significance level except reliability% and Average quantity of cocoons used/day/basin.

Table 2. Comparative reeling performances of Multi-end reeling machine and Cottage basin.

Parameters	Season	Renditta	Raw silk Recovery(%)	Reelability(%)	Waste(%)raw silk Weight	Raw silk Production/8hrs/10ends(kg)	Avg quantity of cocoons used /day/basin(kg)
Mulity-end reeling machine	S_1	10.46	70.26	63.97	22.10	0.88	5.02
	S_2	11.39	69.31	58.30	23.77	0.86	5.27
	S_3	11.92	66.89	59.88	28.11	0.83	5.11
	S_4	10.26	72.76	70.80	23.06	0.99	5.00
Mean±SD		11.01±0.74	69.80±2.22	63.24±5.07	24.26±2.41	0.89±0.09	5.10±0.25
Level of significance		**	**	**	**	NS	NS
Cottage basin	S_1	11.39	69.31	62.78	23.40	0.89	5.05
	S_2	12.72	66.68	66.80	25.10	0.85	5.09
	S_3	12.63	65.91	63.02	28.38	0.80	4.96
	S_4	11.09	69.87	68.54	25.91	0.90	5.02
Mean±SD		11.95±0.78	67.94±1.79	65.28±4.38	25.70±1.91	0.86±0.04	5.03±0.26
Level of significance		**	**	**	**	**	NS

**significant at P<0.01, NS=Not significant

Table 3. Comparative quality characteristics of silk reeled on Multi-end reeling machine and Cottage basin.

Parameters	Season	Avg.size (d)	Size diviation	Maximum size diviation	Winding break/40 skeins	Tencity(g/d)	Elongation
Improved cottage realing machine	S$_1$	21.00	1.97	2.33	11.00	3.35	18.54
	S$_2$	22.97	2.07	2.51	14.00	3.09	17.78
	S$_3$	23.40	1.90	2.80	16.67	2.81	18.11
	S$_4$	22.44	1.92	2.39	10.33	3.16	20.39
Mean±SD		22.45±0.97	1.97±0.13	2.51±0.27	13.00±3.16	3.10±0.24	18.70±1.07
Level of significance		**	NS	**	**	**	**
Traditional cottage basin	S$_1$	22.97	2.86	3.88	17.33	3.11	17.88
	S$_2$	23.39	3.08	3.75	17.00	2.69	18.07
	S$_3$	24.23	2.99	3.14	19.00	2.72	20.33
	S$_4$	23.21	2.93	2.72	16.33	2.82	18.16
Mean±SD		23.44±0.61	2.96±0.12	3.37±0.55	17.42±2.07	2.83±0.23	18.61±1.06
Level of significance		*	NS	**	NS	NS	**

**significant at P<0.01, NS=Not significant

From the Table 2 it was also observed that Multi-end reeling machine shows better reeling performances compare to the cottage basin which correlated with the results of Sonwalkar et al. (1983) and Hariraj et al. (1992).

In the present study variations of reelabillity % was observed between locations and within season, which are in agreement with Sinobwalkar et al. (1983) who commented that it may be due to cocoon drying, cooking and reeling methods used. It was also observed from this Table that mean production of raw silk per 8 hours reeling of multivoltine cocoon was obtained about 0.904 kg in multi-end reeling machine and 0.858 kg in cottage basin. Hariraj et al. (1992) and Sonwalkar et al.

(1990) noted that they obtained 1.14 kg and 1.00 kg raw silk per 8 hours reeling of multivoltine hybrid cocoon in improved cottage reeling machine, which correlates with our findings. So, the reeling performance of multivoltine cocoon on BSRTI fabricated multi-end reeling machine was found very satisfactory than existing cottage basin.

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Table 3 exhibited the quality characteristics of silk reeled on Multi-end reeling machine and cottage basin. From the Table it was observed that mean size (denier) and size deviation were found 22.45 and 1.97 in multi-end reeling machine and 23.44 and 2.96 in cottage basin respectively which indicates that the reeler was able to maintain all 10 ends with required number of cocoons per end during the reeling period on improved cottage reeling machine. It was also found that mean tenacity and elongation percentage were 3.10 (g/d) and 18.70% in multi-end reeling machine, whereas it was 2.83 (g/d) and 18.61% in cottage basin respectively. From the results it is clearly observed that denier, size deviation, tenacity and elongation percentage of raw silk reeled on multi-end reeling machine showed better results compared to cottage basin. Sonwaldar et al. (1990) and

Hariraj et al. (1992) reported 3.9 (g/d) and 19.20% and 3.98 (g/d) and 18.10 tenacity and elongation % respectively of raw silk reeled on multiend reeling machine which correlates with the present findings of raw silk reeled on fabricated multi-end reeling machine. M.A. Qader et al. (2000-2004) studied on the performance and quality of raw silk production with improved cottage reeling machine and also suggested to use it for better production.

From the above discussion it is suggested that the BSRTI fabricated multi-end reeling machine is an improved reeling appliances which can use commercially to get high quality raw silk production through all seasons in Bangladesh.

Acknowledgment

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