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Comparative Study of Commercial Characters of Cocoon Produced by Ripe and Unripe Bivoltine Larvae (*Bombyx mori* L.) Mounted at Different Maturation Levels

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To study the effect of mounting fully ripe and unripe silkworms at different maturation percentage, the ripe and unripe silkworms were mounted separately and observed the cocoon and reeling characters. The significant difference in the cocoon and reeling parameters was observed between all ripe and unripe batches except for summer season. The silkworms collecting together and mounting at a time can be recommended only in summer season and at certain level during rainy season.

Key words: Ripe and unripe larvae, Mounting, Cocoon and reeling parameters, *Bombyx mori* L.

Introduction

The efforts are to workout strategies, which could lead to the enhancement of cocoon crop both qualitatively and quantitatively at a reduced feeding level. The appropriate mounting time, the percentage of ripe larvae and the types of mountages decide the quality the cocoon crop. The mounting operation of silkworms after completion of the larval period is one of the most busy and laborious works in silkworm rearing and if the mounting of silkworms is not done at a proper time and in a suitable mountage, this will lead to loss of silk and further cocoon quality will deteriorate. Silkworm rearers should adopt Japanese type Jobarai system of collecting mounting silkworms in which mulberry shoots along with silkworms are shaking by using a platform and silkworms are collecting together and mounting. It has the advantage of saving 40% of labour and it facilitates mounting of all the silkworms at a time. Fakuda *et al.* (1963), Naito *et al.* (1987) and Bora *et al.* (1994, 1995) reported that quantum of mulberry leaf fed to the 5th instar silkworm has direct relationship on the growth, development and cocoon characters. Takano and Arai (1978) studied the relationship with cocoon productivity and mulberry leaf intake. However, reports are scanty about the feed cut in the penultimate stage of the 5th instar and to know the critical period of starvation without sacrificing commercial characters of cocoon. So, it is essential to undertake a comparative study of parameters connected with cocoon and post cocoon of fully matured and unmatured silkworm mounted at different maturation levels. Moreover it is important to know that what maturation level the silkworms can be mounted simultaneously at a time so that labour and time also conserved and quality of cocoon is maintained.

Materials and Methods

The silkworm larvae of new productive bivoltine hybrid (CSR2×CSR4) were reared up to fourth moult in standard recommended rearing and feeding conditions (Kawakami, 2001) by providing V1 variety of mulberry leaves. The freshly moulted fifth instar larvae were grouped in to 4 batches, each batch with 5 replication of 400 larvae each and were reared by providing required quantum of quality mulberry leaves and bed spacing. In the present experiment, during the end of fifth age, percentage of matured larvae for spinning were assessed and the ripe and unripe larvae were colleted and mounted when ripe larvae reached to 30%, 50%, 70% and 90%,

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respectively, in a particular group. In the first group when 30% of the silkworms were ripe these larvae were mounted separately in smaller trays, in which plastic collapsible mountage were fixed. The remaining 70% unripe larvae were separately mounted in bigger trays fixed with plastic collapsible mountages. Similarly, in other groups the ripe larvae and unripe larvae were mounted separately. Cocoon harvesting was done on sixth day after mounting and cocoon assessment was carried out subsequently. The cocoon characters like cocooning percentage, single cocoon weight, single shell weight, shell ratio and melting percentage were calculated separately for ripe and unripe groups. Hundred cocoons from each replication of each groups (ripe and unripe larvae) were subjected to reeling operation. Calculated the post cocoon parameters like average filament length, non-breakable filament length (NBFL), denier, renditta, raw silk percentage and reelability of fully ripened larvae formed cocoon and the data were compared with their own respective unripe larvae formed cocoon. The experiment was conducted in different seasons (Rainy, Winter and Summer) at Central Sericulture Research and Training Institute, Mysore, India (Environmental conditions are given below). The data were tabulated and statistically analysed by using simple student t test for comparing different groups of ripe and unripe larva formed cocoon.

- Summer : March – June, 29 – 35°C, 40 – 50% Relative humidity
- Rainy : July – September, 25 – 27°C, 70 – 90% Relative humidity
- Winter : November – January, 18 – 25°C, 50 – 60% Relative humidity

Results and Discussion

Cocooning percentage denotes survivability of larvae and formation of cocoon. Highest cocooning percentage was recorded when 90% ripe silkworms were mounted (Table 1, G4a). The cocooning percentage was significantly different in all unripe and ripe groups except in rainy seson. During first 4 days in 5th instar of silkworm called obligatory feeding period and starvation after this stage onwards doesnt affect cocooning percentage (Calvez, 1981). The present study also indicated that all unripe larvae also formed cocoon during all the season, though percentage of cocooning was comparatively low. Similar results were reported by Takano and Arai (1978) and Bora *et al.* (1994). The single cocoon weight is directly related to quantum of mulberry leaves fed and ingested in 5th instar (Ito, 1967; Naito *et al.*, 1987).

Significant difference of melting percentatge in ripe and unripe larvae were recorded when silkworms mounted at different maturation level (Table 1). Samson *et al.* (1981) reported that less feeding of mulberry leaves causes starvation and increased the disease incidence and resulted in poor cocoon crop.

Significant difference of single cocoon weight was recorded when ripe and unripe silkworms were mounted during winter season. However, in summer season and rainy season there was no significant difference recorded when silkworms were mounted at different maturation level (Table 1). During winter season due to low temperature generally larval duration of silkworm prolongs and for maturation and spinning also silkworms takes more time. The single cocoon weight is directly related to quan-

Table 1. Comparative performance coccon parameters of ripe and unripe larvae mounted at different maturation level

Groups	Percentage of ripe/unripe larvae	Cocooning percentage (%)			Melting percentage (%)			Single cocoon weight (g)			Single shell weight (g)			Shell ratio (%)		
		S	R	W	S	R	W	S	R	W	S	R	W	S	R	W
G1a	30% ripe	90.00 **	94.40 *	94.01 **	1.66 **	1.66 **	1.66 **	1.40 **	1.87 NS	1.57 NS	0.320 NS	0.432 NS	0.361 NS	22.85 NS	23.12 NS	22.99 NS
G1b	70% unripe	87.10	92.00	83.80	2.14	2.50	2.14	1.35	1.86	1.55	0.302	0.424	0.342	22.37	23.83	22.10
G2a	50% ripe	89.00 **	95.00 *	95.66 *	1.50 **	1.50 **	1.50 **	1.42 NS	1.86 NS	1.52 *	0.334 NS	0.455 NS	0.369 NS	23.52 NS	24.42 **	23.33 NS
G2b	50% unripe	85.00	94.50	92.33	2.50	3.00	2.50	1.39	1.85	1.56	0.328	0.428	0.362	23.59	23.11	23.14
G3a	70% ripe	91.00 **	94.00 *	94.04 *	1.07 **	1.78 **	1.07 **	1.49 NS	1.86 NS	1.58 *	0.348 NS	0.448 NS	0.368 *	23.35 NS	24.08 **	23.29 NS
G3b	30% unripe	88.00	91.00	91.66	2.50	3.30	2.50	1.47	1.85	1.54	0.341	0.426	0.354	23.21	22.94	22.91
G4a	90% ripe	93.00 **	96.00 NS	93.03 **	0.80 **	1.10 **	0.80 **	1.51 **	1.92 NS	1.54 **	0.353 **	0.455 NS	0.368 **	23.39 **	23.68 NS	23.89 **
G4b	10% unripe	89.00	95.50	86.66	2.50	2.50	2.50	1.41	1.88	1.47	0.311	0.421	0.325	22.04	23.36	22.10

*Significant at 5% level; **Significant at 1% level; NS-Non-significant, S-Summer, R-Rainy and W-Winter.

tum of mulberry leaves fed and ingested during 5th instar. It was observed that there is direct relation between the feed quantum and the cocoon weight (Ito, 1967; Sumioka *et al.*, 1982).

Comparative study results of different ripe and unripe larval groups shows that there was no significant difference of shell weight observed between ripe and unripe larvae mounted at different maturation levels during summer and rainy season (Table 1). This indicates after attaining certain maturation level, the mounting of unripe larva doesnt affect the shell weight of the cocoon during summer and rainy season.

Significant difference of shell ratio was not observed between different ripe and unripe larvae mounted and formed cocoon (Table 1). The results indicated that mounting early or before the actual maturation doesnot affect the shell ratio. The silkworms reached at certain maturation level can be mounted at a time without sacrificing the shell ratio.

Average filament length denotes length of the bave contained in the cocoon shell. Significant difference of average filament length was observed between G1a & G11b and G2a & G2b during all season (Table 2). However, during summer season there was no significant difference observed between G3a & G3b and G4a & G4b. The results indicated that early mounting of silkworm affects the average filament length except during summer season. The study pointed out that the mulberry leaves consumed by the silkworm after 4th day of 5th instar was primarily utilized as raw material for formation of cocoon fibre and reached the maximum level at 5th or 6th day. Fakuda *et al.* (1963) reported a direct relation ship of mulberry leaves consumed by the silkworm on different day and the incorporation to silk filament.

Non-breakable filament length (NBFL) is very essential for calculating filament continuity and more number of breaks getting from inferior cocoons. Significant difference of NBFL was observed between different unripe and ripe groups except during summer season (Table 2).

Denier denotes thickness of the filament. Significant difference of denier was recorded when compared different unripe and ripe groups except during summer and rainy season (Table 2). It was reported that less quantum of feed intake resulted thinner size of the filament and vice versa. The increase or decrease in filament size is due to the quantum of feed given to the silkworm during 5th instar (Naito *et al.*, 1987; Bora *et al.*, 1995).

Renditta is the quantity of cocoon in kilogram required to produce one kilogram of raw silk and it represents the actual silk content available from the cocoon. In majority of the group there was a significant difference observed between ripe larvae and unripe larvae formed cocoon except during summer (Table 2). During summer season no significant difference recorded in between G3a & G3b and G4a & G4b. Bora *et al.* (1995) reported that lower feed quantum and starvation affect the renditta. The highest and lowest renditta was due to more quantum or less quantum of feed consumed by the silkworm and converted into silk protein. However, the present study indicated that in a population of silkworm reared with optimum condition of feed and bed spacing if above 50% of the worms are mature the entire population can be mounted at a time during summer. Das *et al.* (1994) reported that among reeling parameters *viz.*, average filament length, renditta

Table 2. Comparative performance post cocoon parameters of ripe and unripe larvae mounted at different maturation level

Group	Average filament length (m)			Non breakable filament length (m)			Denier			Renditta (kg)			Raw silk percentage (%)			Reelability (%)		
	S	R	W	S	R	W	S	R	W	S	R	W	S	R	W	S	R	W
G1a	921	991	953	803	886	848	2.56	2.76	2.58	5.45	5.48	5.54	18.34	18.24	18.05	88.33	84.00	74.92
	*	**	**	NS	**	**	**	**	**	**	*	*	**	**	**	NS	NS	NS
G1b	899	935	904	802	839	788	2.78	2.53	2.84	5.82	5.67	5.69	17.18	17.63	17.57	87.73	84.70	73.22
G2a	1012	1097	1046	814	943	898	2.46	2.43	2.51	5.26	5.12	5.22	19.01	19.53	19.15	89.33	86.00	83.20
	**	**	**	NS	**	**	**	**	**	**	*	**	**	**	**	*	NS	NS
G2b	989	1046	995	802	868	836	2.78	2.63	2.67	5.58	5.54	5.57	17.92	18.05	17.95	84.26	83.05	79.50
G3a	986	1088	981	786	904	897	2.59	2.54	2.56	5.48	5.22	5.41	18.24	19.15	18.48	88.36	85.50	82.24
	NS	**	*	*	**	**	**	**	**	NS	**	*	NS	**	*	**	NS	NS
G3b	983	982	961	804	806	867	2.38	2.76	2.22	5.49	5.57	5.53	18.21	17.95	18.08	81.02	82.12	79.34
G4a	980	1020	1012	775	814	804	2.64	2.89	2.80	5.56	5.29	5.34	17.98	18.90	18.72	87.32	79.86	80.01
	NS	**	**	*	**	**	NS	NS	**	NS	**	**	NS	**	**	NS	NS	NS
G4b	986	962	965	755	761	765	2.54	2.84	2.43	5.78	5.66	5.69	17.30	17.66	17.57	79.25	79.14	79.05

*Significant at 5% level; **Significant at 1% level; NS-Non-significant, S-Summer, R-Rainy and W-Winter.

and reelability exhibit no significant change due to diet rationing.

Raw silk is the ultimate percentage of the quantity of raw silk reeled in relation to the quantity of fresh cocoon utilized for reeling. It was observed that there was a significant difference between all the ripe and unripe larval groups mounted at different maturation levels except during summer. During summer season no significant difference was observed between G3a & G3b and G4a & G4b (Table 2). The results indicated that mounting of unmatured worms significantly affects the raw silk percentage except during summer, in summer season due to high temperature maturation of larvae usually take place quickly. However, Bora *et al.* (1995) and Naito *et al.* (1987) reported that severe feed cut significantly affect raw silk percentage comparing to ten percentage feed cut.

Reelability indicates the suitability of cocoon for economic reeling. In most of the cases no significant difference of reelability was recorded between different ripe and unripe larval treatments mounted at different maturation level. More over, reelability is a racial character early mounting of unripe larvae doesnt affect the reelability of cocoon. This result were supported by Vijayakumari *et al.* (2001) under less feeding condition.

The study results indicated that there was a significant difference in the cocoon and reeling parameters between unripe and ripe larvae mounted groups except during summer. This is because during summer season temperature goes up and maturation of worms also take place quickly, so that during winter season worms collected together and mounting at a time may be avoided.

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