Effect of cold storage of newly hatched larvae on survival rate, growth and egg production in silkworm *Bombyx mori* L.

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MS received 6 April 1988; revised 5 December 1988

Abstract. Effects of refrigeration (5 ± 1°C) of newly hatched silkworm larvae on survival rate, growth and egg production were studied in two multivoltine races, Pure Mysore and Hosa Mysore. When refrigerated for 10 days, moth emergence (males: 83·3% vs 89·4% and females: 92% vs 90·2%) and fecundity (465·5 vs 458·3) did not differ significantly from the control. Reductions in cocoon weight by 4% (1·323 g vs 1·271 g) and 10·7% (1·323 g vs 1·181 g) were caused by 5 and 10 days of refrigeration. Marked increase in early stage (I and II instar), loss of larvae (12·9% vs 48·8%), decrease in effective rate of rearing (77·1% vs 33·5%), pupation rate (92·4% vs 65%) and reproductive rate (137·7 vs 36·9) were observed, when refrigerated for 10 days. Results on reproductive rate indicated one day's refrigeration as safe period in Hosa Mysore but not in Pure Mysore. In December season, both races showed higher tolerance and possibility of safe refrigeration up to 2 days.

Keywords. *Bombyx mori*; early stage loss; effective rate of rearing; pupation rate; reproductive rate; egg production.

1. Introduction

Refrigeration of cocoon or pupa, moth, egg and larva at one or more stages are followed to synchronise silkworm rearing with the availability of mulberry leaf. In silkworm seed production, refrigeration of seed cocoon and moth are inevitable to adjust adult emergence or effect mating of desired parents. Usually, refrigeration of cocoon is limited to 1 to 2 days, though the recommendations are up to 3 days for female and 7 days for male pupa (Tazima 1962; Jolly 1983). In case of moths, it is limited to 3 days in female and 7 days in male (Ullal and Narasimhanna 1978; Jolly 1983). The efficiency of mating of male moths was improved, when kept at 5 ± 2°C (Subramanyam 1982). Bivoltine eggs, characterised by hibernation, are refrigerated at 2·5°–7·5°C for different period to activate them to hatch at the desired time (Mizuno 1920; Watanabe 1931; Katsukake 1952). The non-hibernating multivoltine eggs can be cold stored on second day at 5°–7°C to postpone hatching up to 24 days (Dutta *et al* 1972). Eggs at blue body stage can be refrigerated for 2 to 3 days at 5°C to delay hatching (Tanaka 1964). Refrigeration of newly hatched silkworm larvae is also not uncommon, especially when hatching is irregular and a single brushing is desired. However, unlike other stages of pupa, moth and egg, information on refrigeration of hatched larva and subsequent rearing performances are limited though not totally lacking (Jolly 1958, 1983; Tazima 1962; Tanaka 1964). The present study is carried out to understand more about the effect of refrigeration of newly hatched silkworm larvae on their rearing performances and reproductive rate.
2. Materials and methods

Two multivoltine races, Pure Mysore (PM) and Hosa Mysore (HM) were used. Newly hatched larvae refrigerated for 1–10 days and the control without refrigeration formed different treatments. Refrigeration was done at 5±1°C and RH 75±5%, in a commercial silkworm seed cold storage. Hatched larvae, continuously for 10 days from freshly prepared layings for each day, were refrigerated and were released on a single day to facilitate brushing and rearing at a time. Each treatment consisted of 3 cellular replications. Rearing was conducted as per standard recommendations (Krishnaswami et al 1973). Test was repeated in 3 distinct seasons [June-July 1986 (S₁), August-September 1986 (S₂) and December 1986 (S₃)] to concur the results.

Different parameters studied were lost during early instar (I and II) rearing (early stage loss = ESL), effective rate of rearing (ERR), cocoon weight, pupation rate (PR), female and male moth emergence, fecundity and reproductive rate (RR). The definition of these terms and calculations are interpretable as given in standard sericulture text books (Krishnaswami et al 1973; Ullal and Narasimhanna 1978; Narasimhanna 1988) and related publications (Krishnaswami 1978, 1979; Benchamin and Krishnaswami 1981a, b). Analysis of variance (3 way factorial) was carried out for interpretation of results.

3. Results and discussion

3.1 Survival rate

In the present study, all treatments recorded significant increase in ESL of worms compared to control and it increased with the increased days of refrigeration (table 1). The ERR was reduced significantly in all treatments, when refrigerated for 10 days. ESL increased from 12.9–48.8% and ERR decreased from 77.1–33.5%. Inability to feed and moult normally, resulting in irregular growth, were characteristic of larvae refrigerated for more than 5 days in both the test races. Those larvae that survived in these treatments were also prone to viral and bacterial diseases in later instars. Starved larvae in silkworm Bombyx mori are more susceptible to flacherie (bacterial disease) and grasserie (viral disease) (Samson et al 1981). In the present study, even refrigeration for 1 day caused 18.6% increase in ESL (12.9% vs 15.3%) and 7.1% reduction in ERR (77.1% vs 71.6%).

Significant races × treatments and races × seasons interaction (table 6) showed specific advantages of HM race over PM and S₃ season over other seasons. For example ESL in 1 day refrigerated batch and ERR up to 2 days refrigeration in HM, were not significantly different from the control. In PM, increase in ESL and reduction in ERR were significant in all treatments (table 2). In respect of ESL and ERR, 2 days refrigeration was found safe in S₃ season.

3.2 Growth

Cocoon weight is directly correlated to the larval body weight. It reduced significantly in all treatments when compared to control, but did not vary significantly