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Growth rate pattern and economic traits of silkworm, *Bombyx mori* L under the influence of folic acid administration

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ABSTRACT- Influence of oral administration of folic acid to 5th instar silkworm larvae of a popular Indian bivoltine hybrid (CSR2 x CSR4) was studied. Folic acid solution spraying on mulberry leaf and feeding to silkworm significantly improved larval weight, silk gland weight and growth rate. Higher larval and silk gland weight subsequently improved the economic parameters like cocoon weight, shell weight and shell ratio of folic acid treated batches. @JASEM

Fortification of mulberry leaves by using supplementary nutrient and feeding to the silkworms is a useful modern technique to increase economic value of cocoon (Kumararaj et al. 1972). Fortification of food with certain vitamins successfully tried as a prophylactic measure in silkworm (Ito and Niminura, 1966a). Supplementation with vitamin B increased the resistance against poor environmental conditions and increased body weight in silkworm (Das and Medda, 1998). Riboflavin enhances the silk production and reduced the uric acid excretion and the choline and its derivatives sprayed on mulberry leaf and feeding to silkworm enhanced the fiber yield (Ito, 1978). Ascorbic acid is reported to enhance the larval survival rate (Ito and Niminura, 1966 a and b). Nutritional background of the larval stage is significantly influences the status of the resulting larva, pupae, adult and fiber (Fukuda et.al, 1963;Takano and Arai 1978; Aftab Ahmed et al.1998; Rahmathulla et al.2002). Although the mulberry leaves are complete diet for silkworm and sometime it is possible that some deficiencies occur due to different reasons. The supplementation of extra nutrients along with mulberry leaves results higher yield because the production of superior quality and quantity of silk depends mainly on nutritional status and healthiness of the larva. Folic acid or folate is one of the B Vitamin important for healthy growth of human foetus and it is essential for the normal development of baby's spine, brain and skull and also reported that it is necessary for nucleic acid biosynthesis in insects. Folic acid acts as a co-factor and is essential in the reaction of transforming phenyl alanine in to tyrosine. It was also reported that dietary supplementation of folic acid to silkworm larvae did not significantly increase the glycogen content of the body, where as in haemolymph trehalose content increases significantly (Nirwani and Kaliwal, 1996a). The present study was undertaken to evaluate the influence folic acid (Vitamin B) on growth rate pattern, development of silkworm larva, silk gland and subsequent production of quality cocoons.

MATERIALS METHODS

The present experiment was carried out at Central Sericultural Research and Training Institute (C.S.R&T.I) Mysore, India. The silkworm breed selected for the experiment was a popular bivoltine hybrid CSR2 × CSR4. This breed is a highly productive developed by the silkworm breeders of CSR&TI, Mysore, along with the collaboration of Japanese subject experts (1992-97). Mass young age silkworm rearing of one batch was conducted by feeding with V1 mulberry variety as per the standard rearing package (Rajan *et al,* 2001). Parallelly another batch was maintained as per the standard recommendation by feeding with semi synthetic diet (Nutrid) recently developed by CSR & TI, Mysore. After 3rd moult both batches of larvae were shifted to leaf feeding and continued separately up to 4th moult by provide with V1 mulberry variety. The freshly moult out 5th instar larvae of both batches (leaf and diet) were replicated in to three groups. In each group, with 200 larvae were kept and reared at a temperature of 25 ± 1ºc and a relative humidity of 75 ± 5 %. The group- 1 (control) larvae was considered as carrier, control fed with normal mulberry leaf sprayed with distilled water however the group 2 & 3 were the experimental groups (T1 & T2) and the larvae were fed with leaves sprayed with two different concentration of folic acid solution (100 ppm and 150 ppm). The commercial folic acid available in the market was used in the present experiment (Central Drug house, Mumbai). Mixing of folic acid in distilled water made up to the required concentration. The known quantity of leaf recommended for each feeding (Rajan et *a l.,* 2001) sprayed with folic acid solution and air-dried for some times (15 minutes) and given to silkworm. The treatment was initiated on the first day of fifth instar by spraying folic acid solution at varying concentration separately and was continued up to maturation of larva.

Growth rate pattern of silkworm was studied and weight of five male and female larvae from each treatments and replications was observed from the subsequent day of treatment onward till spinning.

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After taking weight of each larva the silk gland was dissected out and using tissue paper drained water out and weight of the gland was recorded. The mature larvae were mounted in plastic collapsible montages separately treatment and replication wise and cocoon harvesting of was done on 6th day and subsequently cocoon assessment was carried out. Single cocoon weight, shell weight, shell ratio, Effective rearing rate (ERR) by No weight were also recorded (Formulae given). The experiment was repeated thrice in different seasons and the data were subjected to the statistical analysis (Anova) to determine the significance.

$$\text{Growth index} = \frac{\text{Final weight of the larvae (g) - Initial weight of the larvae (g)}}{\text{Initial weight of the larvae (g)}}$$

$$\text{Weight of single cocoon} = \frac{\text{Weight of 10 male cocoons + Weight of 10 female cocoons (gm)}}{\text{No. of cocoons taken (20)}}$$

$$\text{Single shell weight} = \frac{\text{Total shell weight of 10 male cocoon + 10 female cocoon shell (gm)}}{\text{Total no of cocoons taken (20)}}$$

$$\text{Shell ratio (\%)} = \frac{\text{Single shell weight (gm)}}{\text{Single cocoon weight (gm)}} \times 100$$

$$\text{ERR by number} = \frac{\text{Total no. of good cocoons harvested}}{\text{Total no. of larvae retained after 4th moult}} \times 10{,}000$$

$$\text{ERR by weight} = \frac{\text{Weight of good cocoons harvested in kg}}{\text{Total no. of larvae retained after 4th moult}} \times 10{,}000$$

RESULTS AND DISCUSSION

Growth rate pattern of silkworm

Growth rate pattern of 5th instar silkworm was studied under the influence of folic acid administration. Maximum improvement in larval growth was noticed during 144 hrs in both leaf as well as diet batches (fig -1). The improvement in larval weight was recorded maximum in T2 followed by T1 and control. The folic acid treated silkworm gained more weight than control and the weight was steadily increased from 24 hrs. The influence of folic acid administration at different concentration on 5th instar silk gland growth pattern indicated a steady increase of silk gland weight from 24 hrs onwards. However, there was a maximum improvement of silk gland weight was noticed in T2 during 144 hrs in both leaf and diet batches (fig-2).

It was reported that**,** there was no significant difference of larval duration in between treatments and control in both leaf and diet batches (Table-1). From the above result it was clear that folic acid administration doesn't make any difference in larval duration of 5th instar silkworm. The larval weight of silkworm was recorded for different treatments before ripening. In leaf batch significantly higher larval weight was recorded in T2 (48.51g) followed by T1 (46.62g) when compared with the control (41.18g). In case of diet batches similar trend was recorded (Table-1). Similar results were obtained by administration of folic acid (Nirwani and Kaliwal, 1996a; Rai, *et al,* 2002). Increase in larval weight was noticed when administrated with other vitamins on different silkworm races *viz*-administration of thiamine (Nirwani and Kaliwal, 1996b), thyroxine (Rajashekargouda *et al,* 1998), ascorbic acid (Etebari, 2002; Babu *et al*, 1992). Supplementation of mulberry leaves with Vitamin B12 could increase the synthesis of nucleic acids and protein in the silk gland of silkworm (Das and Medda, 1998).

Table – 1 Effect of folic acid administration on growth of larva and cocoon parameters of bivoltine silkworm

Parameters	Leaf batch					Diet batch				
	T1	T2	Control	CD@5%	SE±	T1	T2	Control	CD@1%	SE±
5th Instar Larval Duration (hrs)	148	147	149	- NS	-	148	147	149	- NS	-
Final Larval Weight 10 nos (g)	46.62	48.51	41.18	1.96 **	0.44	46.84	48.48	41.45	2.00 **	0.45
Growth Index	3.894	4.132	3.390	0.17 **	.038	3.880	4.080	3.340	0.15 **	.035
Single Cocoon weight (g)	1.91	1.94	1.73	0.08 **	0.02	1.92	1.96	1.75	0.12 **	0.02
Single shell wt. (g)	0.46	0.49	0.39	0.02 **	0.005	0.46	0.49	0.40	0.02 **	0.005
ERR No.	9472	9491	9506	- NS	-	9465	9484	9502	- NS	-
ERR Weight (kg)	17.97	18.40	16.33	0.90 **	0.20	17.83	18.42	16.30	0.90 **	0.20
Shell Ratio (%)	24.08	25.25	22.54	1.14 **	0.32	23.95	24.99	22.85	1.48 **	0.33

** Significant at 1%; SE± -Standard Error

In leaf batch higher growth index was recorded in T2 (4.132) followed by T1 (3.894) and control (3.390). Diet batch also same trend of result was obtained *i.e.* T2 (4.080), T1 (3.880) and control (3.340). So, it was cleared that folic acid administration and its higher concentration causes better growth in silkworm larva.

Economic traits of silkworm

Effective rearing rate (ERR) indicates the survivability of silkworm during the silkworm crop. There was no significant difference of ERR

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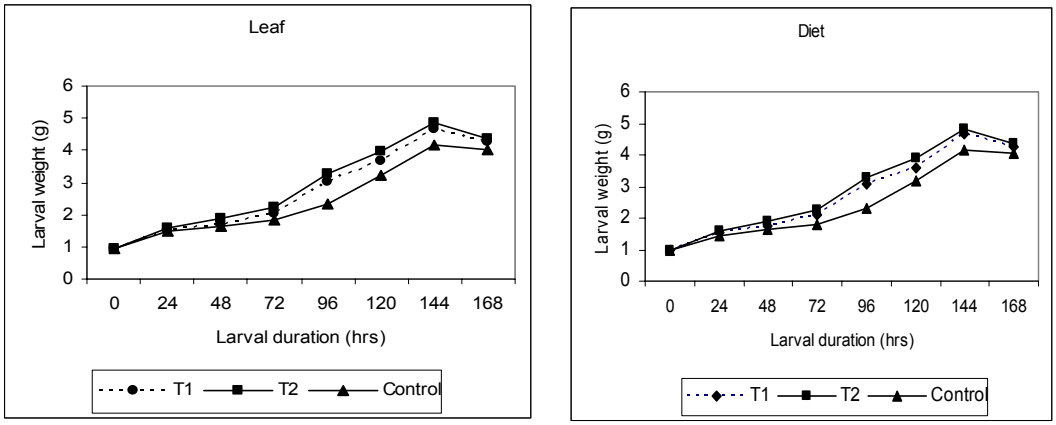
by number recorded between treatment and control in leaf and diet batches. The results show that application of folic acid does not affect survivability of silkworm.However, In case of leaf batch ERR by weight was recorded significantly higher in T2 (18.40 kg) followed by T1 (17.97 kg). Similar results were obtained in case of diet batch also (16.30kg) (Table-1). These results were in agreement with the earlier workers (Nirwani and Kaliwal, 1996a; Rai, *et al,* 2002; Etebari, 2002). In support of this present result showed that folic acid act as a growth promoter and significantly increases the yield per weight of cocoon.

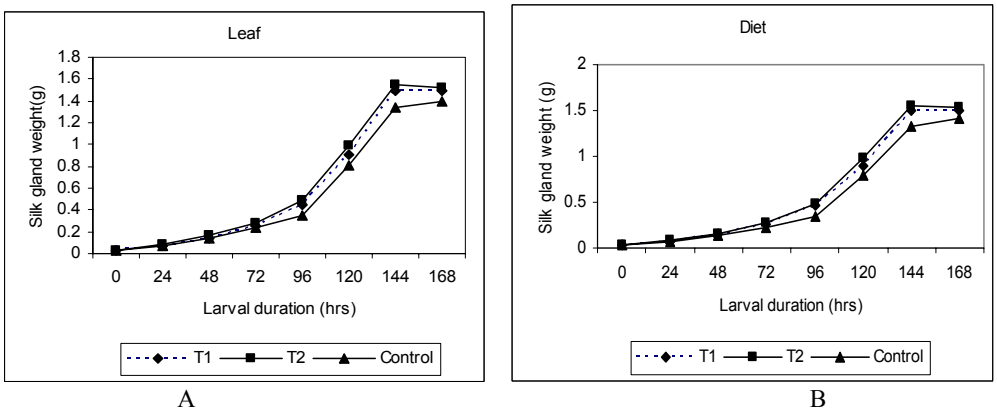
In leaf batches single cocoon weight was significantly higher in T2 (1.94g) followed by T1 (1.91g) and lower in control. (Table 1). In case of diet batch also same trend of result was recorded and higher in T2 (1.96 g) followed by T1 (1.92 g) and control (1.75g) (Table 1). The study results were in agreement with administration of thiamine (Nirwani and Kaliwal, 1996 b; Rai et al*,* 2002). thyroxine (Rajashekargouda et al.1998) and ascorbic acid (Etebari,2002; Babu et al,1992). Administration of folic acid significantly increased the shell weights. In leaf batch significantly higher shell weight was recorded in T2 (0.49g) followed by T1 (0.46g) and control (0.39g). In case of diet batch same trend of result were obtained as T2 (0.49g), T1 (0.46g) and control (0.40g) (Table 1). However, Etebari (2002) showed that hyper vitaminosis does not only cause enhancement of larval and cocoon weight but it also has many negative effects. McFarlane (1992) has suggested that high levels of ascorbic acid can inhibit the spermatogenesis in some insects and decrease the viability of produced eggs.

In leaf batch shell ratio was significantly higher in T2 (25.25%), followed by T1 (24.08%) and control (22.54%). In case of diet batch same trend was recorded as T2 (24.99%), T1 (23.95%) and control (22.85%) (Table 1). So, it was clear that folic acid administration to silkworm through leaves improved the shell ratio percentage. The same result was obtained by (Nirwani and Kaliwal, 1996b; Rai et al*,* 2002 Rajashekargouda et al.1998; Etebari, 2002; Babu et al, 1992). The study results concluded that the oral administration of folic acid during 5th instar silkworm significantly influences the growth rate pattern of silkworm larva and silk gland. This higher growth and development also influences the economic characters like cocoon weight, shell weight and shell ratio and subsequently quality of silk.



A B

Fig –1 Influence of folic acid on growth rate pattern of silkworm larva (A- leaf, B diet batch)



A B

Fig –2 Influence of folic acid on growth rate pattern of silk gland (A- leaf, B- diet batch)

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