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Effect of Food Supplementation by N and Ascorbic Acid on Larval Mortality of Silkworm (*Bombyx mori* L.)

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Abstract: The study was carried out to determine the effect of 0.2 % N in combination with different doses of ascorbic acid (0.025, 0.075, 0.100, 0.125 and 0.150%) on larval growth and silk production of silk worm larvae (*Bombyx mori* L.). The larvae were fed on mulberry leaves treated with given doses of nitrogen and ascorbic acid throughout the larval period. It was observed that all the growth parameter were influenced by food supplementation. The larvae which were offered mulberry leaves treated with 0.2% N + 0.150% ascorbic acid showed lower mean values of body weight, body length, food consumption, coefficient of utilization and cocoon shell ratio but higher mortality rate.

Key words: Silkworm, larval growth, nitrogen effect, food consumption

Introduction

The rearing of silkworm (*Bombyx mori* L.) on commercial basis for the production of cocoon to obtain raw silk is an important cottage industry since the dawn of human civilization. Silkworm has been used as a sole source of natural silk for producing exquisite textile and dress material (Anonymous, 1973).

China is playing a significant role in international silk trade by supplying about 90% of the world's imports of the raw silk. It exported silk fabrics and finished silk goods $ 1.49 billion out of the total $ 2.1 billion in 1991 and has large for the year of 2000 of $ 2.7 billion. Japan has always been by far the largest consumer of silk in the world (Anonymous, 1992). In Pakistan, the production is insufficient and about 30,000 boxes of silk seed are being imported from Japan, Korea, Brazil and China (Akram *et al*., 1993).

The total annual demand for silk yarn and fresh cocoon is approximately 655 and 6500 metric tons, respectively, valued about 5000 million rupees. About 300 metric tons of dry cocoon are produced locally where as 555 metric tons of raw silk is imported annually (Ahmad and Park, 1988). So, it is required to increase the production of silk to meet the domestic needs and to earn foreign exchange by exporting raw silk or finished silk goods. Different scientists worked on food supplementation of silkworm larvae to meet the requirements of natural silk production and much information has been compiled on nutritional significance of individual substances in the rearing of silkworm by using the chemically defined diets and their supplementation through mulberry leaves. Shafique (1993) reported that dry matter consumed by silkworm was directly proportional to nitrogen contents of the leaves. Mahmood (1989) found that nitrogen increased the body weight of larvae and gave better cocoon production. He concluded that leaves dipped in 0.2% N solution produced the larvae with maximum weight as compared to the other doses Rehman (1997) concluded that optimum doses of minerals in various combinations, when used enhanced silk production and silkworm growth to a greater extent than control. During the entire larval life mean food was converted into body matter was 74.55%.

Ito (1980) concluded that application of artificial diet in silkworm larvae has great impact on larval growth rate of silkworm and silk production. El-Karaksy and Idriss (1990) observed that ascorbic acid enhanced silk yield of mulberry silkworm. Khurram (1998) noted a combined effect of 0.2% N + 0.1% P + 0.3% K and 0.1% Ca and stated that it has a spectacular effect on the growth of silkworm. It has also been observed that the quality of silk was also improved.

This study was conducted to determine an appropriate combination of nitrogen and ascorbic acid for better larval growth and silk production.

Materials and Methods

The eggs of Japanese strain of silkworm (*Bombyx mori* L.) were obtained from Sericulture Department of National Agricultural Research Centre, Islamabad. The study was conducted during March-June, 2001. The eggs were placed at ambient temperature of 25 ± 2 °C and relative humidity of 70-80% in an incubator for hatching.

After hatching, larvae were isolated from stock culture and divided into 27 groups of 50 larvae each. The larvae were reared in card board boxes measuring 22 x 15 x 5 cm^3 covered with polythene sheet turned over card boards to prevent moisture loss.

The larvae were subjected to following treatments there were 9 treatments:

Treatment	Details
T1	Simple mulberry leaves
T2	Mulberry leaves dipped in water
T3	Mulberry leaves dipped in 0.2% N solution
T4	Mulberry leaves dipped in 0.2% N + 0.025% vitamin C
T5	Mulberry leaves dipped in 0.2% N + 0.05% vitamin C
T6	Mulberry leaves dipped in 0.2% N + 0.075% vitamin C
T7	Mulberry leaves dipped in 0.2% N + 0.10% vitamin C
T8	Mulberry leaves dipped in 0.2% N + 0.125% vitamin C
T9	Mulberry leaves dipped in 0.2% N + 0.150% vitamin C

Different combinations were prepared from urea and ascorbic acid (vitamin C) except T_1 and T_2 ,simple leaves and leaves dipped in water, respectively (Suleman, 1999). 0.2 % N was used because it was determined as the best dose (Mahmood, 1989; Din, 1996; Rasool, 1995; Suleman, 1999) First three larval instars were fed on chopped mulberry leaves of *Morus alba* and last two were offered full grown leaves, thrice a day. Before feeding, the leaves were dipped in treatment solutions and dried in shade. At the start of 4th instar, 40 larvae with best vigour and uniform size were maintained in each replication of each treatment and the rest were discarded.

Experiment was carried out in completely randomized design (CRD). The larval length and weight were recorded on the last day of each instar using scale and electronic balance, respectively. The data recorded on cumulative food consumption of all instars, cumulative coefficient of utilization of all instars and mortality was analyzed statistically. Duncan's multiple range test was applied to test the significance of results (Steel and Torrie, 1985).

The residual leaves and faeces were collected separately and dried in an oven at 100 °C for 24 hours and food consumption was measured after (Arsen'ev and Bromlei, 1957).

$$\text{Food consumption} = \text{Dry weight of leaves offered} - \text{Dry weight of residual leaves}$$

The coefficient of utilization (CU) of food was calculated by Evans (1939).

$$CU = \frac{\text{Dry weight of food consumed} - \text{Dry weight of faeces}}{\text{Dry weight of food consumed}} \times 100$$

Table 1: Effect of treatments on food consumption, coefficient of utilization and mortality of silkworm (*Bombyx mori* L.)

Treatments	Food consumption g/10 larvae	Coefficient of utilization (%)	Mortality (%)
T1 (Simple mulberry leaves)	44.55±1.20de	59.96±0.55e	4.33±0.58b
T2 (Mulberry leaves dipped in water)	48.93±0.78b	63.52±0.41c	4.00±1.00bc
T3 (Mulberry leaves dipped in 0.2% N solution)	52.65±0.45a	66.39±0.76b	4.00±1.00bc
T4 (Mulberry leaves dipped in 0.2% N + 0.025% vitamin C)	53.74±1.95a	66.84±0.48b	2.66±0.58bc
T5 (Mulberry leaves dipped in 0.2% N + 0.05% vitamin C)	55.20±2.02a	71.11±0.09a	2.33±0.58c
T6 (Mulberry leaves dipped in 0.2% N + 0.075% vitamin C)	48.47±2.76bc	62.13±1.68d	2.33±0.58c
T7 (Mulberry leaves dipped in 0.2% N + 0.10% vitamin C)	45.81±1.36cd	59.31±0.03e	4.33±1.53b
T8 (Mulberry leaves dipped in 0.2% N + 0.125% vitamin C)	4327±1.65de	55.68±0.49f	6.66±1.53a
T9 (Mulberry leaves dipped in 0.2% N + 0.150% vitamin C)	41.60±1.73e	52.74±0.79g	7.00±1.00a

Means sharing with same letters are not significantly different at $P \leq 0.05$

Results and Discussion

The data (Table 1) indicated that the leaves treated with 0.2% N + 0.05% ascorbic acid (T5) were the most preferred ones (55.20 ± 2.02) for food consumption. Similarly, high rate of utilization was recorded in T5 (71.11 ± 0.09), which was followed, by T4 and T3 (Table 1). The maximum food consumption and coefficient of utilization was observed in T9. The maximum mortality (7.00 ± 1.00) was observed in T9 (0.2% N + 0.150% vitamin C) and minimum (2.33 ± 0.58) in T5 (Table 1). The pattern followed by mortality is same in the case of food consumption and coefficient of utilization.

From given results (Table 1), it is quite obvious that larvae fed on mulberry leaves treated with 0.2% N + 0.150% vitamin C (T9) supplement caused higher mortality (7.00 ± 1.00) and lower cumulative food consumption (41.60 ± 1.73) and coefficient of utilization (52.74 ± 0.79). It can be further concluded that T5 0.2% N + 0.05% vitamin C proved as the best treatment while higher doses of vitamin C might cause deterioration in larval growth and increase mortality in silkworm larvae. Our findings are in conformity to those of Akhtar and Asghar (1972) who found that vitamins and mineral salt played an important role in the nutrition of silkworm larvae, and also with those of Ashfaq *et al.* (1996), who concluded mineral supplementation affect the growth and development of silkworm larvae, as in our case 0.2% N + 0.150% vitamin C caused mortality of larvae. It has been observed that T1 (simple mulberry leaves) and T2 (mulberry leaves dipped in water) showed lesser mortality than the treatments in which higher doses of ascorbic acid was used. Treatments in which lower doses of vitamin C were used gave low mortality rate.

These results (Table 1) depicted that treatment (T5) in which appropriate dose of ascorbic acid was used gave better food consumption and better coefficient of utilization values, was the best among all the test treatments. Suleman (1999) found that appropriate doses of mineral nutrients gave higher values of food consumption and coefficient of utilization (57.086 g/10 larvae and 78.81 %, respectively). He also observed lower mortality rate (2.92 ± 0.58) as compared to treatments with higher doses. These findings are also in agreement with Javaid (1991) and Nadeem (1996) who reported that silkworm larvae fed on mulberry leaves supplemented with mineral nutrients gave good food consumption and coefficient of utilization but low mortality (2.12 ±0.63 and 3.64 ± 0.52, respectively).

Thus, it can be concluded that better combination of nitrogen and ascorbic acid (0.2% N + 0.05% vitamin C) gave higher mean values of food consumption and coefficient of utilization but low rates of mortality. Rehman (1997) found similar impact of different doses nitrogen and concluded that higher doses resulted in decline food consumption and coefficient of utilization (10–30 % as compared to control). While treatments in which higher doses of ascorbic acid were used, gave higher rates of mortality.

The present studies showed that mulberry leaves supplemented with 0.2 %N and different doses of ascorbic acid had great effect on growth of the silkworm larvae i.e., food consumption, coefficient of utilization and mortality. These studies will help in determination of food supplementation doses regarding ascorbic acid in order to get the best lot of silkworm larvae that would give best silk production, hence, helping in better establishment of silk industry. These studies will also help in lowering mortality of the silkworm larvae.

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