



ORIGINAL ARTICLE

Consumption and utilization of leaves of *Paulownia fortunei* by the larva of *Spilarctia obliqua* (Lepidoptera: Arctiidae)**Mohammad Faisal¹, K.P. Singh² and Mukhtar Ahmad²**¹Advance Institute of Science & Technology, Selaqui, Dehradun, India²Entomology Division, Forest Research Institute, Dehradun, IndiaEmail: faisal_fri@yahoo.comReceived: 02nd August 2016, Revised: 03rd September 2016, Accepted: 07th September 2016**ABSTRACT**

Spilarctia obliqua is considered as a potential polyphagous pest capable to cause considerable damage to many forestry and agricultural crops in the absence of their primary pest. During present study potentiality of the larvae of *S. obliqua* in consuming the foliage of *Paulownia fortunei* and its utilization was studied. The parameters recorded during study including duration of larval period, consumption of leaf, weight of faecal matter excreted by the larvae, average body weight, increase in body weight, consumption index (C.I.), approximate digestibility (AD), efficiency of conversion of ingested food (E.C.I.) and efficiency of conversion of digested food (E.C.D.).

Key words: *Spilarctia obliqua*, consumption and utilization, *Paulownia fortunei*

INTRODUCTION

Spilarctia obliqua (Lepidoptera: Arctiidae) is an important polyphagous defoliating insect with broad host range. It is a serious pest of agroforestry, as it causes considerable damage to several forestry and agricultural crops. Beeson (1941) reported *S. obliqua* on numerous species of forest trees including *Butea frondosa*, *Mangifera indica*, *Morus alba*, *Populus deltoides*, *Tectona grandis* and *Toona ciliata*. It is also reported to cause substantial damage to agricultural crops including brinjal, cabbage, cauliflower, knoll-knoll, mustard and radish (Katiyar et al. 1975). Later on, Singh (1992) reported that this pest has been reported to feed on 96 host plants belonging to 34 different families.

Paulownia is a flowering plant belonging to family Paulowniaceae. They are distributed in India, China, south to northern Laos and Vietnam and are also cultivated elsewhere in eastern Asia, notably in Japan and Korea (Wu and Zhu 1997). Kumar and Ahmad (2001) have reported *Paulownia fortunei* as important host of *S. obliqua*. However, the loss becomes significant due to heavy infestation of *S. obliqua* (Sangha et al. 2003, Faisal and Ahmad 2009, and Shatilova et al. 2011). Therefore, to get host suitability, present study was designed on the consumption and utilization of *Paulownia fortunei* by *Spilarctia obliqua*.

MATERIAL AND METHOD

Present study on consumption and utilization of leaves of *P. fortunei* by *S. obliqua* was carried out in the laboratory of Entomology Division at Forest Research Institute, Dehradun. The experiment was performed by gravimetric methods as described by Waldbaur (1968). The experiment was started with newly hatched first instar larvae. Each larva of *S. obliqua* was weighed and placed in two Petri dishes (10 cm diameter) separately. The leaves of *P. fortunei* were collected from different places of FRI campus and brought to the laboratory. The leaves were washed, dried, cut into two equal halves and weighed separately before supply to larvae for feeding. One half was provided as food to the larva in the Petri dish while other half was kept in another Petri dish in the same fashion to determine the moisture loss. From this experiment various parameters like weight of both the halves of the leaf, larval weight, duration and weight of the faecal matter were calculated after every 24 hours. To replicate the experiment, present procedure was followed for three times. This experiment was conducted at 25±1°C temperature and 75±5% relative humidity. Each Petri dish was examined after 24 hours for recording the weight of food consumed, larval

weight gain and weight of faeces released. The moulting of larval instars was also recorded. The data collected during the course of investigation on different larval instars were subjected to analysis of following formula:

$$\text{Weight of food consumed} = \text{Initial weight of leaf} - \text{Weight of leaf after feeding}$$

From the above calculations, following indices were obtained as proposed by Waldbaur (1968).

(1) Consumption index

$$\text{C.I.} = F / T.A.$$

(ii) Efficiency of conversion of ingested food to body substance

$$\text{E.C.I.} = (G \times 100) / F$$

(iii) Approximate digestibility

$$\text{A.D.} = (F - H) \times 100 / F$$

(iv) Efficiency of conversion of digested food to body substance

$$\text{E.C.D.} = G \times 100 / F - H$$

Where,

F = Fresh weight of food eaten

T = Duration of feeding period (days)

A = Mean weight of the insect during feeding

G = Weight gain by the insect during feeding

H = Faecal matter excreted

RESULTS AND DISCUSSION

1. Consumption of leaves by the larvae of *S. obliqua*:

Average consumption of leaf of *P. fortunei* during first instar larva of *S. obliqua* was 114.42 mg (Table 1). The early instars larvae of *S. obliqua* feed scraping the vein of the leaf and later instars feed whole leaf. The consumption of leaf of *P. fortunei* was 1519.49 mg during sixth instar. Hiratsuka (1920) reported that all the lepidopterans consume more food during last two or three instars. The food consumption was increased with increase in age of the larva of *S. obliqua*. It was due to increased size of the larvae and also storage of energy by advanced stages of larvae, which is required during non-feeding pupal stage (Chand 1979).

2. Release of faecal matter by the larvae of *S. obliqua*:

The data on the release of faecal matter by the larva of *S. obliqua* after feeding on host plant *P. fortunei*, showed that total faecal matter, 13.50 mg was released by the first instar larvae. Faecal matter excretion was found dependent on the quantity of food consumed and higher excretion was recorded in the later instars (Table 1). Possibly, it is due to maximum feeding by advanced stages and emptying the alimentary canal by the larvae for pupation (Waldbaur 1968).

3. Effect of different host plants on the larvae of *S. obliqua*:

Larvae of *S. obliqua* were reared host plant *P. fortunei* and average weight of different larval instars was calculated. Average weight of various instars was found as 4.48, 7.52, 16.85, 68.42, 242.68 and 756.51 mg from first to sixth instar, respectively (Table 1). Average weight gained by the larva of a particular instar was significantly higher (1.90, 3.56, 9.31, 51.57, 174.26 and 513.83 mg) in comparison to their preceding instars (Table 1).

4. Consumption index (CI):

Consumption index (CI) indicates the rate of intake of food by the larvae in relation to their body weight in a definite period. Consumption index has shown declining trends (5.90, 5.77, 3.95, 2.00, 1.15 and 0.43 mg/day/mg of body weight) from first to sixth instar (Table 1). The Growth rate (G.R.) indicates the rate of increase in body weight of the larva in per unit duration. Growth rate of the larva of *S. obliqua* showed increasing trends from first to sixth instar (Table 1).

Average rate of increase of body weight during sixth instar was 101.22 mg/day when larvae were given the leaves of *P. fortunei*. The average total growth rate during first instar larvae was observed minimum (0.43 mg/day) (Table 1). Lower growth rate of the larvae could be the result of nutritional inadequacy of the food (Waldbauer 1964).

5. Approximate digestibility (%) of larvae of *S. obliqua*:

Ability of an insect to digest food can be expressed as approximate digestibility (AD). Approximate digestibility was decreased successively from first instar onward recorded minimum in sixth instar (Table 1). Approximate digestibility of the larvae during the sixth instar was 69.34%, whereas it was maximum (88.21%) during first instar (Table 1). The higher approximate digestibility in initial stages indicates the poor suitability of the food plant. It indicates that the early instars require more energy not only for maintenance but also for growth, whereas in the later stages it is required only for maintenance.

Table 1: Consumption and Utilization of leaves of *Paulownia fortunei* by the larvae of *Spilarctia obliqua*

| Larval Instars | Duration of larval instars | Consumption of leaves (mg.) | Release of faecal matter (mg.) | Body weight (mg.) | Increase in body weight(mg) | Consumption Index (CI) (mg/day/mg of weight) | Growth Rate (GR) (mg/day) | Approximate Digestibility (AD) (%) | ECI (%) | ECD (%) |
|----------------|----------------------------|-----------------------------|--------------------------------|-------------------|-----------------------------|--|---------------------------|------------------------------------|------------|------------|
| Ist | 4.30±0.43 | 114.42±2.37 | 13.50±0.88 | 4.48±0.35 | 1.90±0.29 | 5.90±0.36 | 0.43±0.07 | 88.21±0.44 | 1.66±0.14 | 1.88±0.16 |
| IIInd | 4.20±0.62 | 178.63±2.04 | 23.90±0.93 | 7.52±0.36 | 3.56±0.13 | 5.77±0.77 | 0.74±0.28 | 86.56±0.41 | 1.71±0.18 | 2.00±0.18 |
| IIIrd | 4.20±0.43 | 286.28±2.82 | 45.70±1.12 | 16.85±0.72 | 9.31±0.62 | 3.95±0.41 | 2.23±0.20 | 84.00±0.14 | 3.24±0.22 | 3.86±0.25 |
| IVth | 3.60±0.43 | 484.72±4.13 | 93.80±1.98 | 68.42±2.20 | 51.57±2.08 | 2.00±0.40 | 14.03±0.89 | 80.65±0.56 | 10.54±0.75 | 13.07±0.85 |
| Vth | 3.00±0.00 | 872.50±5.51 | 179.80±2.41 | 242.68±2.86 | 174.26±1.82 | 1.15±0.14 | 58.08±1.05 | 79.37±0.22 | 20.64±0.46 | 25.23±0.66 |
| VIth | 4.60±0.43 | 1519.48±3.95 | 466.00±3.03 | 756.51±3.16 | 513.83±2.06 | 0.43±0.13 | 101.22±2.35 | 69.34±0.57 | 33.83±0.67 | 48.77±0.64 |

6. Efficiency of conversion of ingested food (ECI):

Efficiency of conversion of ingested food (ECI) into body matter was taken as percentage of weight gain over food intake by the larva. This indicates the overall efficiency of the insect to utilize the food for growth. The average efficiency of conversion of ingested food into body matter of first to sixth instar larvae of *S. obliqua* were 1.66, 1.71, 3.24, 10.54, 20.64 and 33.83 with respect to first to six instar, when they fed on *P. fortunei* (Table 1). As the development proceeded, ECI values gradually increased. Rao and his associates (1978) also recorded increase in successive instars of *Schistocerca gregaria*, when larvae fed on different food.

7. Efficiency of conversion of digested food (ECD):

Efficiency of conversion of digested food (ECD) into body matter is expressed in per cent weight gain by the larvae over food balance. The average efficiency of conversion of digested food of the larvae during the period from first to last instar were found as 1.88, 2.00, 3.86, 13.07, 25.23 and 48.77% when larvae reared on *P. fortunei* (Table 1). Results of ECD clearly revealed that the early instar larvae feed small quantity of food due to their small body size but digest the food much faster and the maximum energy is utilized for growth activities. In advanced stages, larvae digest comparatively smaller food as limited energy is required by the larvae of later stages for maintenance and more is incorporated into body matter.

CONCLUSION

During present study on food consumption and utilization of leaves of *Paulownia fortunei* by the larvae of *S. obliqua*, it was found that consumption index (C.I.) and approximate digestibility (A.D.) decreased with age but growth rate (G.R.), efficiency of conversion of ingested food (ECI) and efficiency of conversion to digested food (E.C.D.) into body matter were increased with larval age. The changes in these values may be influenced by the digestibility of food and the level of nutrients intake.

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