

**Food consumption and utilization by the Mexican beetle,
Zygogramma bicolorata Pallister (Coleoptera: Chrysomelidae) on
Parthenium hysterophorus Linnaeus**

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ABSTRACT: Quantitative food utilization indices were measured in different larval instars and physiological ages of adult *Zygogramma bicolorata* Pallister. Among the larval and adult stages of the beetle, third instar larvae and egg laying females ingested maximum food. Various growth parameters like relative consumption rate (RCR), relative growth rate (RGR) and approximate digestibility (AD) were relatively higher in the first, third and fourth instar and egg laying females. Efficiency of conversion of ingested food (ECI) and efficiency of conversion of digested food (ECD) were maximum in first, third and fourth instar larvae and decreasing trend was observed in second instar larvae. During preoviposition stage adult, these parameters increased tremendously in contrast to senescent stage.

KEY WORDS: Food utilization, Mexican beetle, *Parthenium hysterophorus*, *Zygogramma bicolorata*

The neotropical weed, *Parthenium hysterophorus* Linnaeus (Asteraceae) is one of the top ten notorious weeds in India. Being a prolific seed producer, it produces up to 25,000 seeds (achenes) per plant (Navie *et al.*, 1996), and 200,000 seeds/m² in abandoned fields in India (Joshi, 1991). It is an extremely aggressive colonizer occupying 200,000 hectares in

India in terrain and mountainous areas. It is believed to have entered India in the early 50s. This weed causes many problems to human health, agriculture, livestock production and biodiversity (Evans, 1997). The first attempt to control the weed in India was made with the introduction of a biological control agent, the Mexican beetle, *Zygogramma bicolorata* Pallister

(Coleoptera: Chrysomelidae) during 1983 (Jayanth and Nagarkatti, 1987). The present study aims to determine the stages of the beetle which would contribute more to control the weed.

MATERIALS AND METHODS

Newly hatched first instar larvae were taken for food utilization studies. The study was carried out at Project Directorate of Biological Control, Bangalore during 1996-97 under laboratory conditions (30°C, 16L: 8D; 60 ± 5% RH). The gravimetric method was adopted for assessing the quantity of food utilized. Ten larvae each of different instars (maintained separately as stock culture) were provided with a cotton swab soaked in distilled water for a period of 16 h to clear the gut contents. After measuring the initial weight, the larvae were introduced into a 5 x 12 cm rectangular plastic container. Before introduction of larvae, preweighed tissue paper (5 x 12 cm) was kept inside the bottom of the container to absorb semisolid faecal material from the larvae.

Premeasured parthenium leaf (measured by Leaf area analyser - Skye Equipment, UK) was provided to the larvae and allowed to feed for 24 h. At the end of each day of the experiment, the side wall of the container was cleaned with a fine camel hair brush to collect the excrement and kept on tissue paper. The tissue paper was dried at 80 °C for a day. The difference in the weight of the tissue paper gave dry weight of the excreta while the difference in weight of the larvae gave the weight gain during the feeding period.

All consumption and growth parameters were measured on dry weight basis. Utilization efficiencies and rates were determined according to Waldbauer (1968) and modified by Scriber and Slansky (1981). The indices used were: Relative Consumption Rate (RCR), Relative Growth Rate (RGR), Approximate Digestibility (AD), Efficiency of Conversion of Ingested Food (ECI) and Efficiency of Conversion of Digested Food (ECD) to Biomass. These indices were calculated as follows:

$$\text{RCR} = \frac{\text{Wt of food eaten}}{\text{Duration of experiment} \times \text{Mean wt of larvae}}$$

$$\text{RGR} = \frac{\text{Wt gain}}{\text{Duration of experiment} \times \text{Mean wt of larvae}}$$

$$\text{AD} = \frac{\text{Wt of food eaten} - \text{Wt of faeces}}{\text{Wt of food eaten}} \times 100$$

$$ECI = \frac{\text{Wt gain}}{\text{Wt of food eaten}} \times 100$$

$$ECD = \frac{\text{Wt gain}}{\text{Wt of food eaten} - \text{Wt of faeces}} \times 100$$

RESULTS AND DISCUSSION

Four different larval instars and three different physiological ages of adults *viz.*, preoviposition, oviposition and senescent (stage incapable of egg production) were taken for the study of food utilization. All the stages preferred laminae and the amount of food consumption varied among the different stages. Data on comparative food utilization of *Z. bicolorata* are presented in Table 1. Among the larval and adult stages, the maximum amount of food ingested was seen in third instar (11.01 ± 0.81 mg/day/larva) larvae and egg laying adult (0.802 ± 0.00 mg/day/ adult). The various growth parameters computed *viz.*, RCR, RGR, AD, ECI and ECD were in accordance with different stages but with some exceptions. The relative consumption rate, growth rate and approximate digestibility were higher during the first and third instar larvae, and in the adults during oviposition stage (Table 1). ECI and ECD were maximum during second and third instar namely, 63.67 ± 3.61 and 74.13 ± 5.56 and least in first instar namely, 31.91 ± 3.06 and 43.25 ± 4.17 , respectively. In adult stages, ECI was higher in the preoviposition period (28.39 ± 2.10), compared to senescent stage adult

(24.39 ± 0.21) (Table 1).

The finding suggests that a number of factors determine the suitability of the host plant for larvae in different stages of development. In the present investigation, the second, third and fourth instar larvae were able to assimilate relatively more as evidenced by higher RCRs. The relative growth rate and approximate digestibility in early instar larvae and oviposition stage of adults were higher indicating that digested food energy is reserved for the future development and during egg laying period of insects. In case of preoviposition and oviposition adult stages, higher assimilation efficiencies were recorded. In view of biocontrol of weeds, the amount of food utilized and biomass reduced by adults or larvae can be utilized to predict the stages which play a significant role in reduction of weed biomass in a given time and space.

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Table 1. Consumption and food utilization parameters of *Zygogramma bicolorata* on *Parthenium hysterophorus*

Life stage	Consumption (mg/day/ind.)	RCR	RGR	AD%	ECI%	ECD%
I -instar	2.67 ± 0.48	0.171 ± 0.03	0.055 ± 0.02	73.78 ± 5.35	31.91 ± 3.06	43.25 ± 4.17
II-instar	5.08 ± 0.25	0.579 ± 0.82	0.637 ± 0.01	80.90 ± 6.22	72.41 ± 6.81	63.67 ± 3.61
III - instar	11.01 ± 5.81	0.723 ± 0.01	0.983 ± 0.01	78.29 ± 4.40	57.04 ± 5.83	74.13 ± 5.56
IV - instar	8.10 ± 0.37	0.891 ± 0.29	0.318 ± 0.01	86.17 ± 3.61	39.20 ± 1.27	46.59 ± 4.26
Preovipositing Adult	0.72 ± 0.00	0.353 ± 0.02	0.420 ± 0.02	60.98 ± 2.10	28.39 ± 2.10	46.55 ± 4.10
Ovipositing Adult	0.80 ± 0.00	0.212 ± 0.00	0.580 ± 0.00	72.56 ± 5.20	27.43 ± 1.00	37.80 ± 2.02
Senescent Adult	0.37 ± 0.00	0.187 ± 0.00	0.057 ± 0.02	40.38 ± 2.20	24.39 ± 0.21	60.40 ± 3.34

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