

Short communication

## Rearing of *Hippodamia convergens* on artificial diet of chicken liver, yeast and sucrose

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### Introduction

Many attempts have been made to rear coccinellid predators on artificial diets (Smith, 1965; Hodek, 1973). In polyphagous coccinellids, *Harmonia axyridis* (Pallas) (Nijima *et al.*, 1986), *Coleomegilla maculata* (de Geer) (Attalah & Newsom, 1966) and *Menochilus sexmaculatus* Fabr. (Matsuka *et al.*, 1972), successful diets were found, while in the case of oligophagous coccinellids, *Coccinella septempunctata* Linnaeus (Kariluoto, 1980) and *Hippodamia convergens* Guer. (Hagen, 1964), only failures have been reported.

In California, adults of *H. convergens* were sold commercially for biological control of aphids and mites (Hagen & van den Bosch, 1968; Rankin & Rankin, 1980). Mass rearing of *H. convergens* on artificial diets is most desirable for commercial scale biological control practice. Rearing of *H. convergens* using artificial diet has not been successful mainly because the adults produced few or no eggs (Hagen & Sluss, 1966; Hagen, 1986). Various formulations of artificial diets have been tested on *H. convergens* adults (Hagen, 1964; Attalah & Newsom, 1966) and larvae (Racioppi *et al.*, 1981). Growth and development were slower when *H. convergens* larvae were fed on an artificial diet consisting of beef liver (Racioppi *et al.*, 1981). A pork liver diet was

successfully used for rearing the coccinellid, *Cleobora mellyi* Mulsant (Bain *et al.*, 1984). An artificial diet of chicken liver has been used successfully to rear *M. sexmaculatus* larvae and adults (Hussein *et al.*, 1986). The aim of this investigation was to test the artificial diet consisting of chicken liver on larvae of *H. convergens*.

### Materials and methods

The chicken liver powder was prepared by first drying the fresh chicken liver in the oven at 60 °C for 12 h, then blending and pulverizing the dried liver into very fine powder. Two other ingredients, i.e. either Brewer's yeast or yeast hydrolysate and sucrose were proportionately added to the mixture giving three different diet formulations, namely FI (liver, Brewer's yeast and sucrose at 3 : 3 : 1 wt/wt ratio), FII (liver, yeast hydrolysate and sucrose at 3 : 3 : 1 ratio) and FIII (liver, yeast hydrolysate and sucrose at 1 : 1 : 2 ratio). The two controls were coddled potato tuber worms (control A) and live pea aphids (control B).

Three grams of the formulation were placed at one corner of a transparent plastic cage (5 by 5 by 2 cm) and a moist cotton dental roll (0.5 cm long) was placed at the opposite corner. For control A and B, 10 potato tuber worms and 30–40 apterous pea aphids were supplied to each larva in each

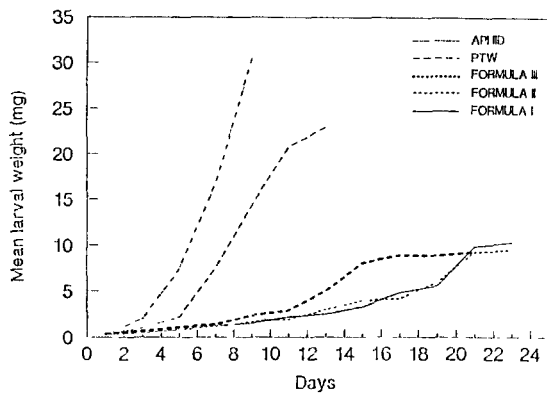


Fig. 1. Mean daily weight gained by larval *H. convergens* when fed on 5 diets.

cage, respectively. One day-old first instar larvae of *H. convergens* were introduced into each cage. Twenty larvae were used for each treatment. Fresh supply of water and food were given every two days. Water and food were inspected daily. Larval weights were recorded on alternate days. Weights of newly emerged adults were also recorded.

## Results and discussion

Figures 1, 2 and 3 summarize the results. The mean weight gained by the larvae on the different diet formulations were in the order of Pea Aphid > Potato Tuber Worm > FIII > FII = FI.

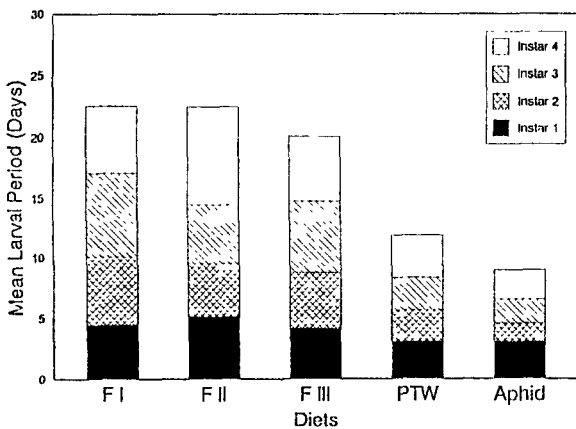


Fig. 2. Mean period of development of larval instars of *H. convergens* when fed on 5 diets.

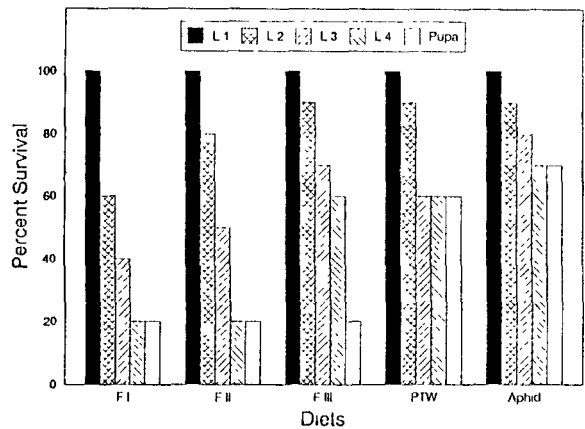


Fig. 3. Percent survival of larva and pupa of *H. convergens* when fed on 5 diets.

Changing the ratio of carbohydrate to protein in the diet from 6 : 1 to 1 : 1 resulted in an increase in larval growth rate (Fig. 1), a decrease in the larval developmental period by 3 days (Fig. 2) and an increase in the larval survival by 15–20% (Fig. 3). The natural diet of pea aphids was still the best in promoting larval growth and development. The natural diet of potato tuber worms was a good substitute for pea aphids. From this study, it is evident that the artificial diet consisting of chicken liver, yeast and sucrose which was used on *M. sexmaculatus* by Hussein *et al.* (1986) is able to support growth and development of larvae of *H. convergens*. The FIII formulation of the artificial diet was found to be superior than FII or FI diets. The mean weights of the newly emerged adults were  $10.7 \pm 1.3$  mg,  $10.8 \pm 1.2$  mg,  $11.8 \pm 1.7$  mg,  $16.2 \pm 0.8$  mg and  $22.1 \pm 3.3$  mg for FI, FII, FIII, potato tuber worms and pea aphids, respectively.

The artificial diets tested in this study could still be improved with the addition of other essential nutrients to provide better larval growth and higher survival rate. The addition of egg yolk to FIII diet could help in improving normal growth and development of *H. convergens* larvae.

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