



## Growth and Developmental responses of *Helicoverpa armigera* (Lepidoptera: Noctuidae) to artificial diet.

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### Abstract

This study aimed to evaluate the feeding responses and development activity and body growth of *Helicoverpa armigera* (Hubner) on three different types of diets at controlled conditions at 25-28°C temperature, 65-75% relative humidity and photoperiod of 14-10(L:D)h. Development was compared at different parameters such as body size of larvae, time to attain maturity (full growth up to 6<sup>th</sup> larval stage), time for pupation and adult emergence, number of pupa and adult formed and also rate of mortality. These parameters were studied on three types of diets such as natural foliage (on chicken pea leaves and pods), on soaked grams and on artificially prepared diet. It was observed that body growth, rate of maturity and number of pupa and adult formed was highest as well as mortality rate and time taken for growth was least in larvae fed on artificial diet. Our results indicated that artificial diet proved to be beneficial for rearing of *Helicoverpa armigera* larvae which is helpful to maintain culture for research purpose.

**Keywords-** *Helicoverpa armigera*, comparative study, growth, diets, artificial diet

### Introduction

Control and management of crop pests is very difficult due to its high mobility, high survival rate, short life cycle span and ability to develop resistance against pesticides (Drake 1991). *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is highly polyphagous pest of many agricultural crops, like cotton, pigeon pea, chickpea, tomato, sorghum and cowpea also on groundnut, okra, peas, field beans and soybeans. It inflicts economic losses to various major crops causing 60-80% damage (Reed and Powar, 1982; Sigsgard *et al.*, 2002). Studies determined the hosts plants of *H. armigera* in India (60 cultivated and 67 wild plants) by Karim (2000), Africa by Pearson (1958), Australia by Zalucki *et al.*, (1986), and in New Zealand by Thane (1987). To study their life history, behavior, feeding habits, and their susceptibility and resistance to chemical and biological pesticides, laboratory rearing is very important. Such lab rearing however required a suitable diet that could improve, culture with all life stages available for studies. Acquisition and allocation of different nutrient molecules required for survival and reproduction of the insects is central to these cultures (Sympson and Raubenheimer 1999). Laboratory diets for culture of insects pest were used earlier by Ahmed (1983): Castane and Zapata (2005). Even successful efforts had been made for lab culturing of *Helicoverpa armigera* on artificially prepared diets by Ahmed (2000): Abbasi (2007) and Jha (2012). In this paper we reared *Helicoverpa armigera* in laboratory using an artificial food and reported the feeding responses with reference to growth, development and survival.

### Materials and methods

Present experiment was conducted in with laboratory temperature at 25-28°, the relative Humidity was 65-75% and available Photoperiod was, 14-10(L:D)h

Three types of diets selected for this experiment were (1) Natural foliage i.e., chicken pea plant

leaves, flowers and pods (2) Grams soaked in water for 8 hours. (3) Artificial diet prepared according to format given by Abbasi *et al.*, (2007): Part A- Agar-Agar powder-16gm, Yeast (dried)-53 gm

Part B- Chick pea flour- 160gm, wheat germ-60gm, Ascorbic Acid- 5.3gm, methyl p/4 hydroxybenzoate-3.3gm, Formaldehyde (10%)-13.5ml, Distilled Water-1100 ml.

Part C- Sorbic Acid, 1.7gm, Evion tablet-1, Becosil capsule powder-1

These ingredients were mixed homogeneously with boiled water containing Agar and Yeast. Mixture was poured in a flat tray and small squares were cut by knife and the diet is ready.

Fresh larvae of *H. armigera* were collected from chickpea fields of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. 25 larvae were reared on natural leaves, 25 larvae on soaked gram and 25 larvae on artificial diet at standard ambient parameters. One set comprised of 25 vials (one larva/vial). 4-5 sets were prepared according to availability of larvae. This process was continued until the larvae grow up to 6<sup>th</sup> instar stage. Within 3 days 6<sup>th</sup> instar larvae entered pupal stage which was kept in separate plastic box having autoclaved soil at bottom. After 12-15 days an adult moth emerged out from each pupa leaving an empty, thin, papery, brown shell. These adult moths were transferred to another rearing chamber. A 50-60cu.cm plastic container was used as oviposition chamber. Mouth of container was covered with muslin cloth. Four pairs of adult moths were released in a container. Two medium sized Petri-dishes containing cotton wool pads soaked in 10% sucrose solution were placed in the chamber to provide food for adults. Minute, greenish coloured eggs were seen at the inner surface of cloth at about 2<sup>nd</sup> to 4<sup>th</sup> day. Eggs hatched into neonatal larvae. Neonatal larvae appear like extremely minute thread like body black head. These neonatal larvae were transferred to another vial containing artificial diet. About 10 neonatal larvae were kept in one

vial. When larvae grew in size and attained 3<sup>rd</sup> instar stage (8-13mm long) they were kept in individual vials as they develop cannibalism property after 3<sup>rd</sup> instar stage. These larvae were considered as 1<sup>st</sup> generation larvae and they were reared in same way by making different sets. From this generation onward we got number of larvae of a particular instar at a time. One set comprised of 25 vials containing one larva in each vial of same instar. In this way 3 lifecycles were completed successfully in 4 months. In each generation one set of larvae was fed on natural leaves and foliage of chickpea and one set on soaked gram.

A gravimetric method described by Waldbauer (1968) was used to evaluate feeding responses of *Helicoverpa armigera* on different diets. Larval weight, food consumed and faeces produced by larvae were measured. Period required to attain maturity, pupation and adult emergence was measured. Mortality was calculated.

#### Results and discussion:

*Helicoverpa armigera* is a highly polyphagous pest of many agricultural crops. In the present study we reared it on artificially prepared diet in the laboratory. The results on growth and development reported better in comparison with regular diet.

**Table-1** depicted comparison between growths and developmental parameters of larvae on three different diets in laboratory. It is reported that the length attained by larvae fed on artificial diet was maximum (34mm) as compared to Larvae fed on soaked gram (29mm) and on natural chickpea leaves (28mm). The table depicted that, the time period required to attain maturity is least in artificial diet fed larvae (16-20 days) which was about 5 days less than that of natural leaves and soaked gram. Rate of mortality too reported to be minimum (4%) on our artificial diet as compared to larvae fed on natural leaves (14%) and soaked grams (12%).

Attainment of Prepupa to pupa took just 3 days in case of larvae fed on artificial diet which was earlier than on other diet. adult emergence of artificial diet fed pupal stage was 12-13 days which is the ideal duration (Hamed and Nadeem, 2008). Adult emergence period was reported to be extended in other diets which were 14 days in larvae fed on soaked gram and 18 days in larvae fed on chickpea leaves. As revealed in fig-1, the minimum mortality was observed on artificial diet (16%) while maximum mortality was on natural chickpea leaves.

Maximum pupal recovery (95%) and adult recovery (96%) was observed on artificial diet whereas less (90% & 90% resp.) and least (81%) on natural leaves.

As tabulated in Table-3, Net adult emergence from mature larvae is 91% in artificial diet, 86% in soaked gram and 73% in natural leaves, which is according to previous work of Burton (1970) who got normal adult emergence after feeding larvae on artificial diet.

Table-1 also denotes number of new larvae produced which propagate next generation. It is clearly seen that larvae fed on artificial diet produce large number of new larvae which is about double than larvae fed on natural leaves. Our results coincides with that of Abbasi *et al.*, (2012), who reported that when *Helicoverpa armigera*, fed with artificial diet during larval stage, larval and pupal developmental period, percent pupating, pupal weight, emergence rate of male and female, longevity, fecundity and hatching were non-significantly different than that of the other natural diets. Boopal and Vageshbabu (2015) got maximum egg yield which is better in comparison with regular diet. Their artificial diet along with Protein proved suitable to overcome the drawbacks during egg laying and was helpful in obtaining appropriate successive generations of *H. armigera*.

**Conclusion;** From present dietary study, it was concluded that artificial diet to be proved more effective for rearing *Helicoverpa armigera* in the laboratory. Such types of lab culture, using different food substrates for *H. armigera* seems to be quite successful with having slender tribulations like moderate feeding behavior, inadequate egg laying and forced or early pupation. If further improvements be made in experimentation they will be a boon, for mass rearing of *H. armigera* in future.

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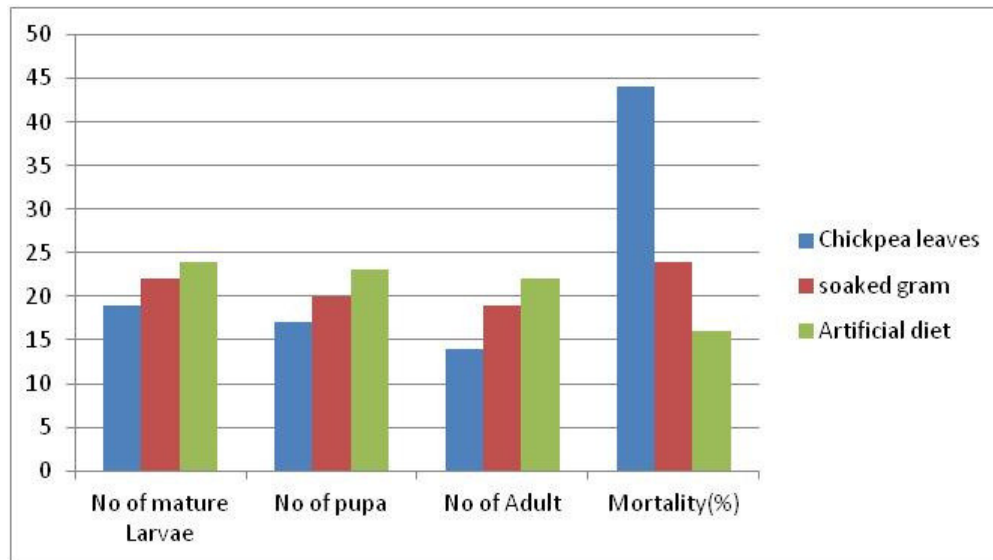
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**Table-1** Growth and development of *Helicoverpa armigera* fed with different types of diets

Type of diet Parameters	On chickpea leaves & pods	On soaked gram	On artificial diet
No of larvae	25	25	25
Time to attain maturity	24days+2	20 days + 2	19 days+2
Body length	28mm	29mm	34mm
No of matured larvae	19	22	24
Larval Mortality	14%	12%	04%
Time for pupation	6 days	4 days	3 days
No of pupa	17	20	23
Adult emergence	15-18 days	13-14 days	12-13 days
No of adults	14	19	22
Adult mortality	44%	24%	16%
No of new larvae	100+_10	160+_10	200+_10



**Figure -1** Growth and development of *Helicoverpa armigera* fed with different types of diets

