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Short Communication

Evaluation of Different Diets for Mass Rearing of *Coccinella undecimpunctata* L. (Coleoptera: Coccinellidae)

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Authors' Contributions
MB and QS conceived and designed the study. MB conducted the experiments, NI analyzed the data. QS and NI wrote the manuscript.

Key words
***Coccinella undecimpunctata*, Artificial diet, *Sitotroga cerealella* eggs, Aphids, Mealybug.**

ABSTRACT

Evaluation of potential of four diets in larval development of lady bird beetle, *Coccinella undecimpunctata*, under laboratory conditions was done. These include mustard aphids (*Lipaphis erysimi*) cotton mealybug (*Phenacoccus solenopsis*), grain moth eggs (*Sitotroga cerealella*) and honey. Results revealed complete development of all larval stages on all diets with maximum survival of lady bird beetle larvae on mustard aphid (76.6%) followed by on grain moth's eggs (20%), immature mealybugs (6%) and the least survival on honey. These findings can lead to the discovery of new artificial diets for the *C. undecimpunctata* for the mass release in fields in order to biologically control a number of pests for an eco-friendly pest control system.

Biological control is an important component of integrated pest management. It involves the control of pest population by natural enemies (Solangi *et al*., 2007). Predators are one of the major agents that control a number of agriculture pests. Predators belonging to the family Coccinellidae are the most active and cosmopolitan predators which feed on a wide range of insect pests including aphids, mealybugs, whiteflies, leafhoppers, and a number of other soft-bodied insects (Gautam, 1989; Obrycki and Kring,1998; Bahy El-Din, 2006). They were also found to feed on the eggs and newly hatched larvae of lepidopterans (Farag *et al*., 2011). Eleven spotted ladybird beetle *Coccinella undecimpunctata* L. is considered to be an important and successful predator of a number of pests attacking cotton, sunflower, citrus and vegetables crops (Ibrahim, 1948, 1955a, b; Ross *et al*., 1980; Smith and Krischik, 2000; Naveed *et al*., 2007; Saeed *et al*., 2007).

The predators can be mass cultured in the laboratory by using various natural and artificial diets (Sarwar and Saqib, 2010). Although, significant research have been done all around the world to explore the rearing techniques of different coccinellid species (Shands *et al*., 1966) but there are few studies conducted for successful rearing of *C. undecimpunctata* under laboratory conditions.

This study is about the diets which can help to rear substantial number of *C. undecimpunctata* in laboratory for mass release to eradicate pests.

Materials and methods

Adults of *C. undecimpunctata* were collected from mustard fields at Central Cotton Research Institute, Multan and released in male and female pairs in plastic cages with fine mesh wire gauze (50×60×40 cm). Sufficient quantity of aphids, *Lipaphis erysimi*, was placed in cages as food for adults. Yellow glaze paper was kept inside the cage for egg laying. Newly laid egg masses were collected and placed into a new petri dish until hatching. The freshly hatched active larvae were used for their development on various diets.

A total of five diets were evaluated for the development of larval stages of *C. undecimpunctata.* The diets included mustard aphid (*Lipaphis erysimi*), 2nd instar mealybug (*Phenoccocus solenopsis*), Eggs of angoumois grain moth (*Sitotroga cerealella*) and honey. Ten freshly hatched larvae of *C. undecimpunctata* were released inside the Petri-dish containing one of the diets. There experiment was replicated three times. The dishes were kept in the laboratory at 25±2°C temperature and larval survival was recorded daily. The diet in each dish was replaced regularly with fresh diets every day. The total number of pupae and adults formed on each diet were also counted.

Results and discussion

The results showed that all diets had strong impact on the development of *C. undecimpunctata.* However, the diet consisting of mustard aphids was the most preferred with maximum survival of newly hatched larvae of *C.*

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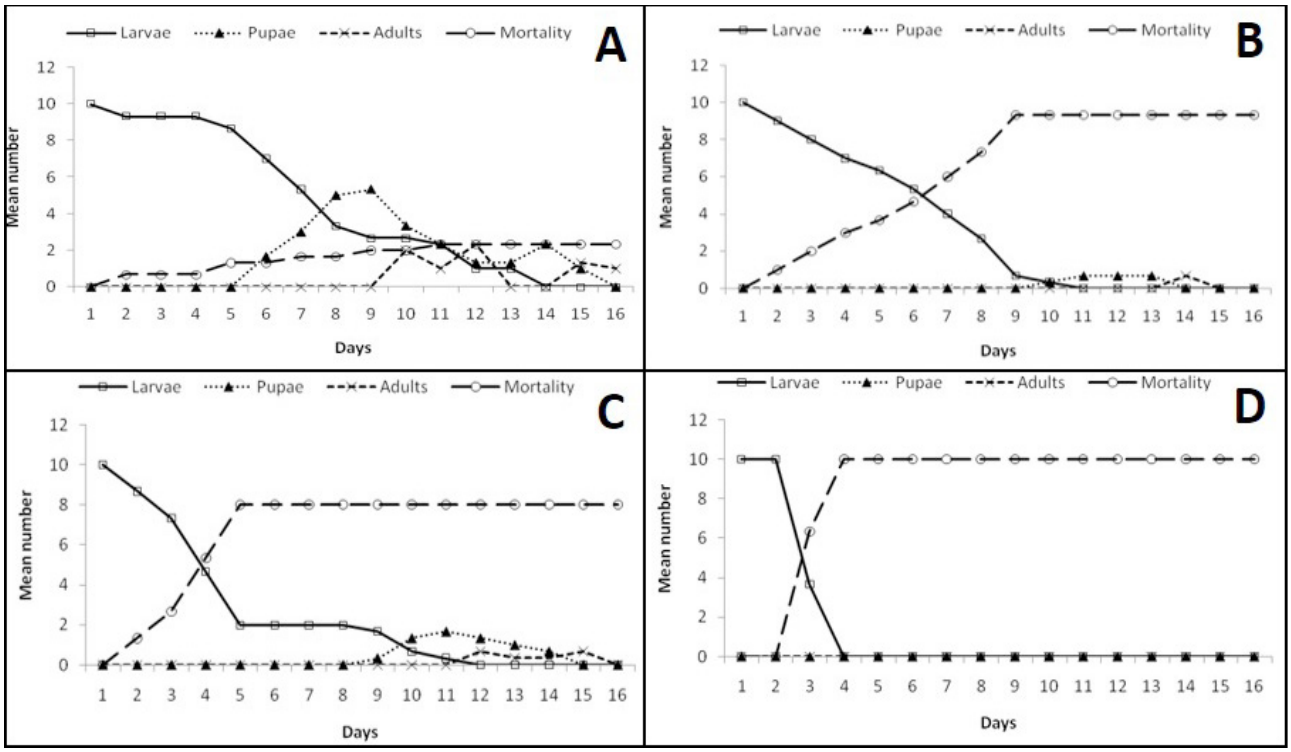

Fig. 1. Development of newly hatched larvae of *C. undecimpunctata* on mustard aphids (A), mealbug larvae (B), *Sitotroga cerealella* (C), honey (D).

undecimpunctata (Fig. 1A). The newly emerged larvae of *C. undecimpunctata* showed complete development to adults with 76.67% survival on mustard aphid diet. Results revealed that pupation started on 5th day and lasted for day 16 while adult emergence was recorded from day 9-16. Figure 1B represented the feeding of newly hatched larvae of *C. undecimpunctata* on mealybugs. The survival percentage was recorded to be 6.667% with a feeding period of 9-10 days. The number of larvae declined till day 9. On day 9, pupation started and lasted till day 14. Adults emerged from day 13 to day 15.

Figure 1C showed the development of larvae of *C. undecimpunctata* on *S. cerealella* eggs. The number of larvae significantly reduced till day 5. Pupation started from day 8-15 whereas adult emergence was recorded from day 11-16. Survival percentage was recorded to be 20% with the feeding days from 6-8.

The results in Figure 1D revealed that development of larvae of *C. undecimpunctata* on honey was the lowest. None of the newly hatched larvae of *C. undecimpunctata* survived even for four days on honey.

Current study showed rearing of *C. undecimpunctata* on four diets. The newly hatched larvae showed development on the three *i.e.,* mustard aphids, mealybugs' larvae and *S. cerealella* eggs. The maximum survival was observed on mustard aphids followed by *S. cerealella* eggs and finally the mealybug larvae. Our results coincided with the findings of Maurice (2011) who observed less and very slow development of coccinalid larvae on mealybug and honey diets. He further proposed that mealybugs could be unpalatable due to their hairy coverings on the body resulting in slow development of beetles.

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Conflict of interest statement

We declare that we have no conflict of interest.

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