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RESEARCH ARTICLE

DEVELOPMENT OF 28-SPOTTED LADYBEETLE *Epilachna vigintioctopunctata* (COLEOPTERA: COCCINELLIDAE) ON THREE FOOD TREATMENTS

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ABSTRACT

Ladybeetles are very recurrently accessible in the gardens as well as in the agricultural fields. On the basis of their feeding habits they can be categorized differently, for instance, those feeding on aphids are aphidophagous while those preferring to feed on coccids are coccidophagaous and the third category is austerely phytophagous and is deliberated as the pest of nightshades and cucurbits. Development of the larvae of *Epilachna vigintioctopuncata* Fabricius, universally known as the 28-spotted ladybeetle was studied by feeding them on three food treatments. One group was fed on the leaves of *Momordica charantia*, other on the flowers of the same plant and the third group was fed on leaves alternated by flowers of bitter gourd. Results specify best survival as well as development among the group fed on leaves followed by food alternation and flowers.

INTRODUCTION

Epilachninae have long been of considerable entomological interest as the major plant-feeding Coccinellidae and may be contemplated as among the most economically important pests among beetles. *Epilachna vigintioctopuncata* Fabricius, the 28-spotted ladybeetle (Coleoptera: Coccinellidae) member of this subfamily is a somber pest of important agricultural crops such as egg plants, potatoes and bitter gourd over an extensive geographical area counting areas of India, Pakistan, China, Japan, SE Asia and Oceania (Richards, 1983; Katakura *et al*., 1988). The peak activity of this species has been noticed from July to August where both the imago and the larvae energetically feed on the epidermal tissues of the host plants. Both adults and the larvae feed by scrapping the epidermal tissue that results in drying up and diminishing of the leaves that is sometimes often referred to as leaf scrapping by the coccinellid beetle (Khan *et al*., 2000). Food plays very essential role in the development of any individual as it provides energy to carry out all the vital activities of body concerned with growth and development. The food preference in the phytophagous ladybeetles is persuaded by odor, taste, vision, age of plant and thickness of leaves along with proportion of crude fiber; parenchymatous tissue and water content in attendance (Imura and Ninomiya, 1978). The number of insect herbivores attacking a host plant is often distressed by the composition and dispersion of the surrounding plant community.

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It is also known that many (not all) specialized herbivorous insects are more likely to attack plants growing in impenetrable monospecific patches (Katakura, 1989). The natural communities of animals are wholly influenced by interspecific interaction (Kareiva, 1983). Widespread dissatisfaction with preceding, largely indirect and observational looms in addressing this problem has led to a topical prominence on field experiments wherein the densities of one or more potentially competitive species are maneuvered in natural settings (Connor and Simberloff, 1986). For the selection and execution of any pest management, the basic requirement is to study the biology of the pest by taking longevity, fecundity, mortality in relation to both host as well as alternate plants. An experiment was carried out to trace out the development of the larvae of *E. vigintioctopunctata* on leaves, flower and leaves alternated by flowers of *Momordica charantia* and the results suggest that leaves are superior food followed by leaves alternated by flowers and flowers resulted in declination of adult emergence.

MATERIALS AND METHODS

Stock Culture

For the maintenance of the stock culture, adults of *E. viginctioctopunctata* were collected from the agricultural fields neighboring Allahabad region (India) and brought to the laboratory. Mating pairs were separated and kept in plastic Petri dishes (9.0x 2.0 cm) in the environmental test chamber (27±1°C; 65±5% RH; 14:10 LD). The mated females laid eggs

that were reared till adult emergence and the eggs laid by the newly emerged adults were used for the experiment.

Experimental Protocol

For the execution of experiment, eggs of different mothers were taken and divided into three groups. Each group contained six larvae per Petri dish. The larvae were allowed to feed on three different food treatments. One group was provided with fresh leaves of bitter gourd, *Momordica charantia* while the other group was presented with flowers of the same plant and the third group was provided with alternated food supply viz., the leaves alternated by flowers of the same plant . The food was replenished after every 24-hours in order to prevent microbial onslaught as well as to trace out different growth parameters chosen for the study. The data on survival incidence of different larval instars followed by the total developmental duration taken by different larval instars in order to complete the development as well as the incidences of mortality were taken into account. The data on 'Survival Incidence' was analyzed by one-way ANOVA by taking 'Food' and 'Different larval stages' into account. The data on the 'Developmental duration' was also analyzed by one-way ANOVA while the data on 'Survival' and 'Mortality' was analyzed by Chi-square test. The experiment was replicated ten times in order to get the trend. The statistical analysis was carried out by using the statistical software Minitab 13.2 (2000).

RESULTS

One-way ANOVA showed a significant effect of 'Food' on the 'Survival Incidence' on the different larval stages of *E. vigintioctopunctata* (L1: F=3.28; P<0.05; L2: F=1.25; P<0.05; L3: 15.43; P<0.05; L4: F=36.88; Prepupa: F=40.35; P<0.05; Pupa: F=40.35; P<0.05) (Fig.1). Chi-square test showed a highly significant effect of leaf on the 'Survival' and 'Mortality' of the larval instars followed by alternate food while a non-significant effect was obtained on the survival and mortality of the larvae fed on flower (Leaf: χ^2=38.400; P<0.0001; Alternate: χ^2=29.400; P<0.001; Flower: χ^2=4.267; P>0.05) (Fig.2) 'Food' also casted a significant effect on the 'Developmental Duration' of different instars of the beetle as indicated by one-way ANOVA (L1: F=6.95; P<0.001; L2: F=1.85; P<0.05; L3: 14.51; P<0.05; L4: F=7.81; P<0.05; Prepupa: F=5.09; P<0.05; Pupa: F=16.63; P<0.05) (Fig.3).

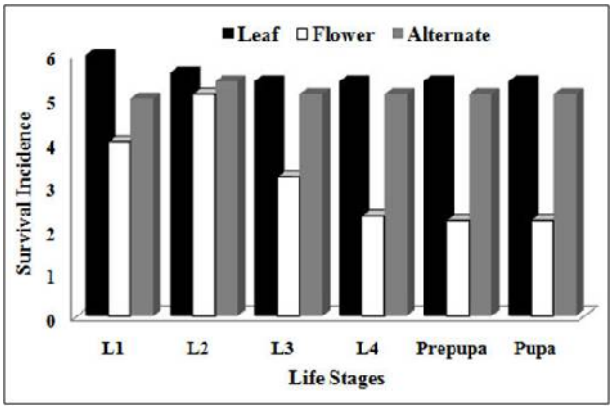

Figure 1. Survival incidence of different life stages of *E. vigintioctopunctata* when fed on leaf, flower and alternate food of *M. charantia*

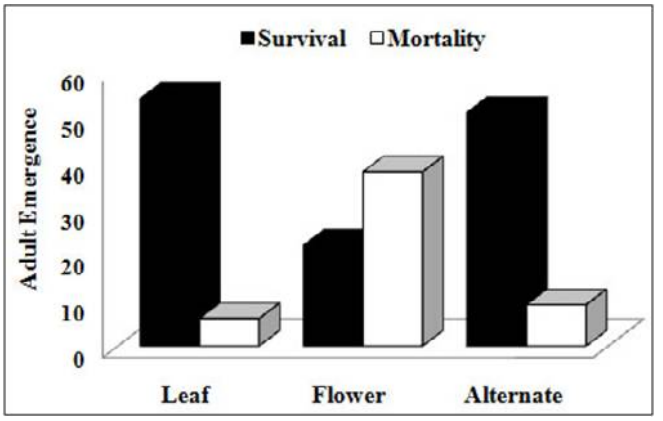

Figure 2. Overall survival and mortality of *E. vigintioctopunctata* when fed on leaf, flower and alternate food of *M. charantia*

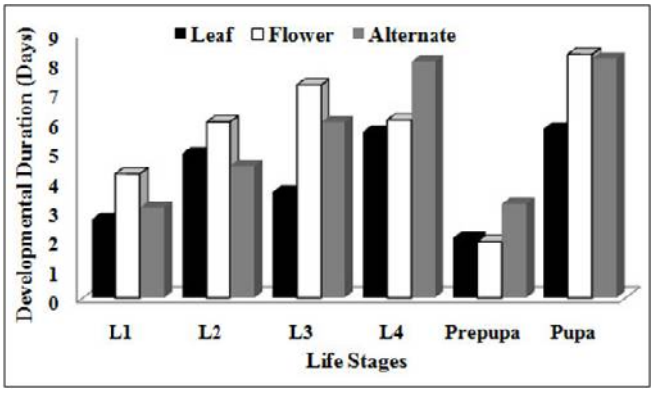

Figure 3. Developmental duration of different life stages of *E. vigintioctopunctata* when fed on leaf, flower and alternate food of *M. charantia*

DISCUSSION

Our results designate that food viz., Leaves, flower and leaves alternated by flowers helps in the survival of the larvae of *E. vigintioctopunctata*. The highest survival ratio was found when larvae were fed with the leaves of *M. charantia* followed by food alternation and least survival was obtained when larvae were presented with flower of the same plant. The mortality was also found to be least when larvae were provided with leaves followed by leaves alternated by flowers while highest mortality was witnessed when flowers were given as food. This can be correlated with the fact that the leaves of bitter gourd are the essential food of this species of ladybeetle. Essential food helps in larval growth and development as well as helps in sustaining development by being rich in all the essential nutrients necessary to sustain survival and however, show varying degrees of favour ability, enabling different developmental rates, fecundity and survival (Conner, 1991, Hodek, 1973). Recent studies have also specified that a mixed type of diet of aphids boost the robustness of ladybird beetles as reported in the aphidophagous ladybeetle *Harmonia axyridis* (Hodek, 1996) qualified to a single species diet. Our studies are in quick agreement with those carried by Maurice *et al*., (2012) on three species of aphidophagaous ladybeetles. Feeding specialization in insects establishes a major adaptation with broad ecological, evolutionary and agricultural ramifications. Foraging behaviour and biochemical adaptations are of key importance to the success of herbivorous specialists (Tauber *et al*., 1986). It is also known that coccinellids are unselective in a choice situation if a mixture of food items are presented and

our studies are similar to those of Maurice and Kumar (2012) on *E. vigintioctopunctata*. The developmental duration was shortest for the leaves followed by leaves alternated by flowers and longest when fed on the flowers of bitter gourd. This can be related by the fact that leaves form high quality food for the larvae providing them ample nourishment to endure development quicker. Food alternation helped the instars to grow at a moderate rate as larvae have to first amend and then adapt themselves for the changed food type every day but such change equipped them to moult ensuing growth but on the other hand, feeding the instars on flowers alone resulted in prolonged development as larvae failed to extract sufficient nutrition from the flowers occasioning higher mortality. The larvae are under peer pressure of pupation so that new generation may emerge resulting in setting up of a strong population build up. It is well known that host selection in phytophagous insects consists of a sequence of behavioural rejoinders to an assortment to stimuli correlated with host and non-host plants. Insects are equipped with sensory receptors that facilitate them to perceive these stimuli and result in feeding (Visser, 1986). Our results are in quick agreement with those carried out on an aphidophagous ladybirdbeetle, *Coccinella transversalis* by Maurice *et al.,* (2011) on essential as well as alternative foods.

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