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Full Length Research Paper

Oviposition of *Epilachna vigintioctopunctata* Fabricius on a wild weed, *Coccinia grandis* Linnaeus (Cucurbitales: Cucurbitaceae)

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The 28 spotted ladybeetle, *Epilachna vigintioctopunctata* (Coleoptera: Coccinellidae) Fabricius is a stern pest of solanceous crops all over the world. An experiment was conducted to study oviposition as well as adult emergence of this species of ladybird when fed on the leaves of a weed, *Coccinia grandis* (Cucurbitales: Cucurbitaceae). Egg laying was noticed when the adults were fed on the leaves of the weed. Food and its quality were found to have significant effect on oviposition (F=591.63). Age of female showed a profound effect on the total number of eggs laid by her (F=1.436). The ratio of the total number of eggs laid and the total number of adults emerged was also significant (χ^2=830.26). Our study wraps up that *C. grandis* can be used as an alternative food for *E. vigintioctopunctata*.

Key words: *Epilachna vigintioctopunctata*, *Coccinia grandis*, oviposition, eggs.

INTRODUCTION

The 28 spotted ladybeetle, *Epilachna vigintioctopuncata* Fabricius (Coleoptera: Coccinellidae) 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 (Nakamura,1976a; Richards, 1983; Kalshoven, 1981; Katakura et al., 1988; Oliff, 1980). Resemblance in size and appearance results in overlapping distribution of these beetles and sometimes their feeding habits also baffle the researchers (Froggatt, 1923). The crest period of infestation of these beetles generally varies with the regions involved. In general 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 (Khan et al., 2000). 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 (Imura and Ninomiya, 1978). This ladybird species harshly distresses the growth and yield of the plant and the damage caused by the larvae is somewhat discrete from that caused by the adult.

Oviposition behavior has been the midpoint of many major debates on the ecology and evolution of interactions between insects and plants: the causes of host specificity, the origin of host shifts, and the potential for sympatric speciation, the modes of coevolution, and the pattern of attack on host plants within local populations. The selectivity of ovipositing females may often present the preliminary foundation for discrepancy of insect populations onto diverse plant species, and it may impel the evolution of some plant defenses. Behavioral, genetic, and ecological determinants of oviposition behavior persuade preference for plants and plant parts in insects (Thompson and Pellmyr, 1991). Food plays a very indispensable role in oviposition as it provides nourishment to the ovarioles that eventually results in egg laying. Both oviposition and feeding of the adults as well as the larvae is distressed by the temperature (Bind, 1998; Pervez and Omkar, 2004; Tilavov, 1981).

For the selection and execution of any pest management, the basic requirement is to study the

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biology of the pest by taking longevity, fecundity, mortality in relation to both host as well as alternate plants. Our study deals with the oviposition of *E. viginctioctopunctata* on *Coccinia grandis* (Cucurbitales: Cucurbitaceae) when provided as food.

MATERIALS AND METHODS

Stock culture

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

Experimental protocol

The prime objective of our study was to trace out the oviposition of *E. viginctioctopunctata* on an alternate host plant, *C. grandis* which is a wild weed easily seen growing in the gardens as well as along the roadsides. The adults that emerged from the pupae were allowed to develop discretely for ten days and then they were allowed to mate. The mating pairs were separated and fed on an ad libitum supply of the leaves of *C. grandis*. The data on fecundity, egg viability and mortality was recorded. To find out the effect of 'food' on oviposition one-way ANOVA was performed. The pattern of oviposition was analyzed by using regression analysis against 'age of female' and 'total number of eggs laid in order to establish the best-fit model by using chi-square analysis. The data on survival and mortality was analyzed by chi-square test. All the statistical analyses were carried out by using the statistical software MINITAB-13.1 (Minitab, 2003). Five replications were used.

RESULTS

One way ANOVA specifies a significant effect of 'food' (leaves of *C. grandis)* on oviposition behavior of *E. viginctioctopunctata* ($F=591.63$; $P<0.0001$) (Figure 1). The Polynomial regression analysis also shows a significant effect of 'age' on 'total number of eggs' laid by the female ($F=1.436$; $P< 0.001$; $df=2$) (Figures 2 and 3). Chi-square also shows a significant effect on the total number of adults emerged out of the total number of eggs laid by the female ($\chi^2=830.26$; $P<0.0001$; $df=1$) (Figure 4).

DISCUSSION

Our studies signify that food plays an imperative role in oviposition behavior of *E. viginctioctopunctata.* It is previously known that food provides energy for carrying out day-to-day activities both in simple unicellular to complex multicellular animals. We selected the leaves of *C. grandis*, which is a wild weed easily identified growing along the gardens and even in the agricultural fields along with the crops. As the leaves devoured by the females supported oviposition it can be advocated that they can be used as a food when the usual food is not accessible. Oviposition behavior is a very multifaceted process and much work on oviposition is supported upon the initiative that females, when tackled with an array of potential hosts, will display a hierarchy in their preferences (Courtney et al., 1989; Singer, 1982; Thompson, 1988a, b; Wiklund, 1981, 1982). When a numeral of potential host plants are accessible, a female will lay most eggs on her most preferred plant species (or habitat or plant part), fewer eggs on her next preferred plant, and so on. Using this decisive factor, specificity is the number of plant species on which a female will oviposit when offered all plants in a simultaneous choice trial. The nutritive value of the host leaves also orient oviposition and analogous results have been found by Jones et al. (1981) and Rahman (2002).

Age or maturity of the female has also been found to have a significant effect on oviposition. Our study specifies that as the age of the female amplifies the egg laying capacity of the female also increases, reaches a peak and then finally declines. This may be due to the fact that during the pre-oviposition period the ovarioles start ripening and their efficiency increases subsequently. The number of eggs laid by the female during the pre-oviposition period is less but their number increases as the female reaches the ovipostion period. Maximum number of eggs is laid during the oviposition period as the ovarioles are fully mature and regular mating with the male also increases their efficiency. It has been found that as the maturity of the female increases the mating duration also increases and mating duration has been found to have a significant effect on oviposition (Jolly et al., 1974). At the peak of oviposition period the number of eggs laid by the female is highest and then the peak declines as the post oviposition period progresses and so the number of eggs being laid per day decreases gradually. This feature may be due to the fact that as the female heads towards ageing the activity of the ovaries producing the functional ova declines so the problem of ovariole functioning becomes prominent. The number of matings as well as the mating duration also decreases so active fertilization fail to crop up resulting in declination of the total number of eggs laid by them. Our studies are in quick agreement with the studies carried out by Dash et al. (1993) and Omkar et al. (2009) carried on the Tasar silk moth, *Antheraea mylitta* and Mexican beetle, *Zygogramma bicolorata*.

Our studies also indicate that there is a significant relationship between the total number of eggs laid by the female and the total number of adults emerged. This can be suggested by the fact that the leaves of *C. grandis* are nutritious enough to sustain the larval development and so a good proportion of adults are emerged. Although studies have also indicated that food does not affect the hatchability of eggs. Austin 1925) which is not in conformity with our results and so this problem requires more concern. The larvae of *E. viginctioctopunctata* are

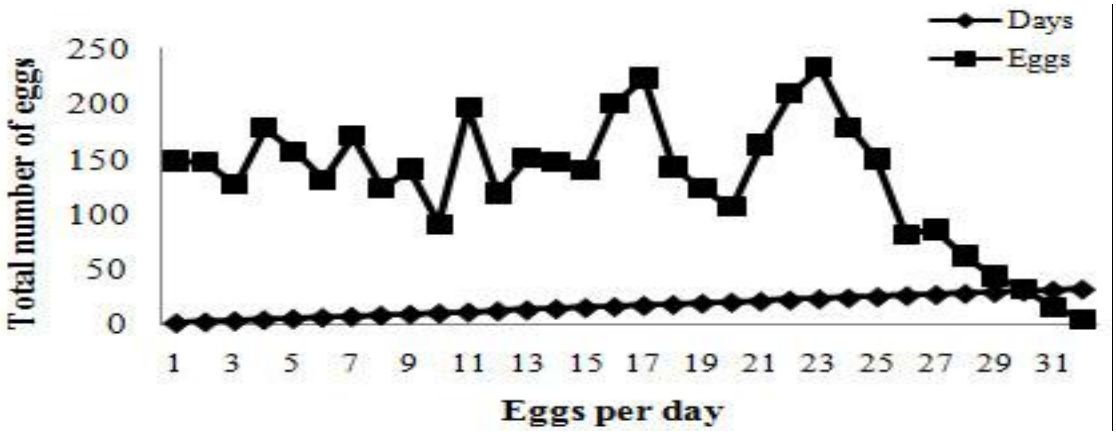

Figure 1. Graph showing relation between total number of eggs and daily oviposition pattern of female of *E. vigintioctopunctata* in leaf of *C. grandis*.

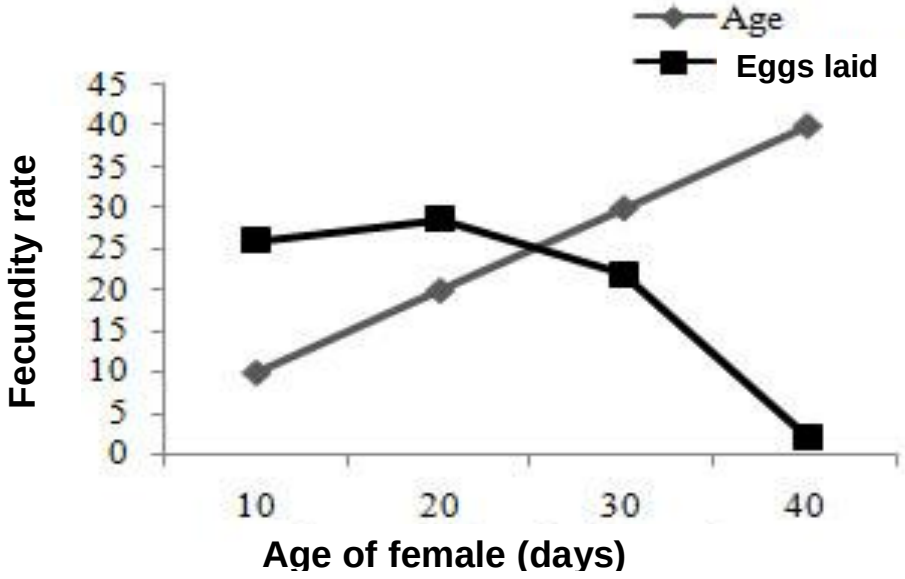

Figure 2. Graph showing relation between fecundity rate and age of female of *E. vigintioctopunctata* when fed on leaf of *C. grandis*.

voracious feeders and their feeding habits as well as nature of damage is somewhat different from that of the imago. The larvae generally confine their attack to the lower surface of the leaves but imago usually feed on the upper surface of the leaves (Prodhan et al., 1990). Larvae of the third and fourth instar are more destructive and voracious. Rajgopal and Trivedi (1989) reported that *Epilachna* beetle may damage up to 80% of plants depending on place and season for variations of existing environmental conditions. So it is clear that the leaves of *C. grandis* can be used as an alternative food for this species of lady beetle.

Since *E. viginctioctopunctata* is a serious pest of major agricultural crops, feeding and oviposition of this coccinellid on the leaves of *C. grandis* it can be suggested that the weed can be used as a trap crop or alternative crop where the usual host plants can be planted in close association with the weed. The damage caused by this pest to the agricultural crops can thus, be minimized up to a certain extent. This problem requires concern.

Our study finally concludes that *C. grandis* supports ovipositionin this lady beetle and the total number of eggs laid by the female during her lifetimes starts increasing, reaches a peak and then finally declines as the female undergoes ageing. The total number of eggs laid and the total number of adults emerged was also found to be significant.

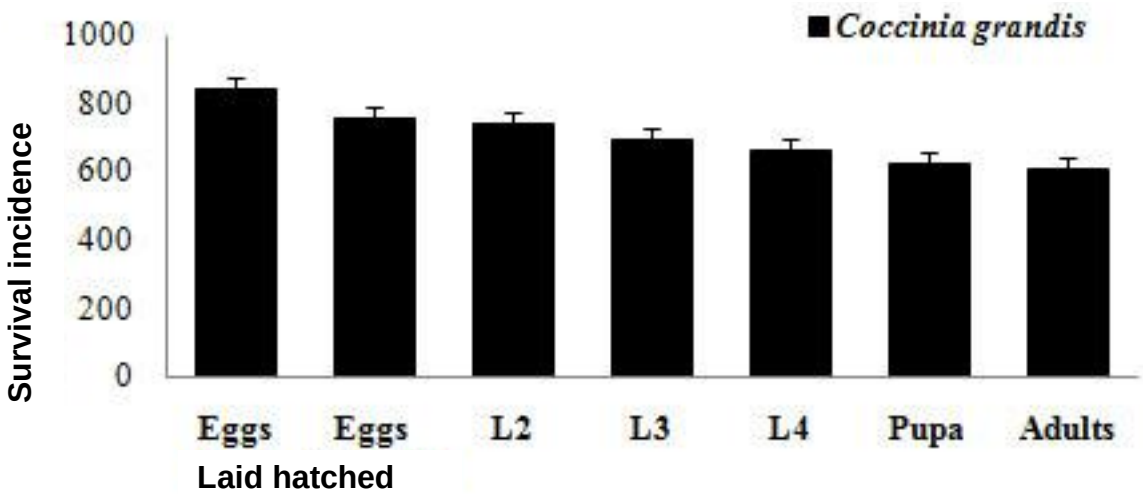

Figure 3. Graph showing relation between survival incidence and different life stages of *E. vigintioctopunctata* when fed on leaf of *C. grandis*.

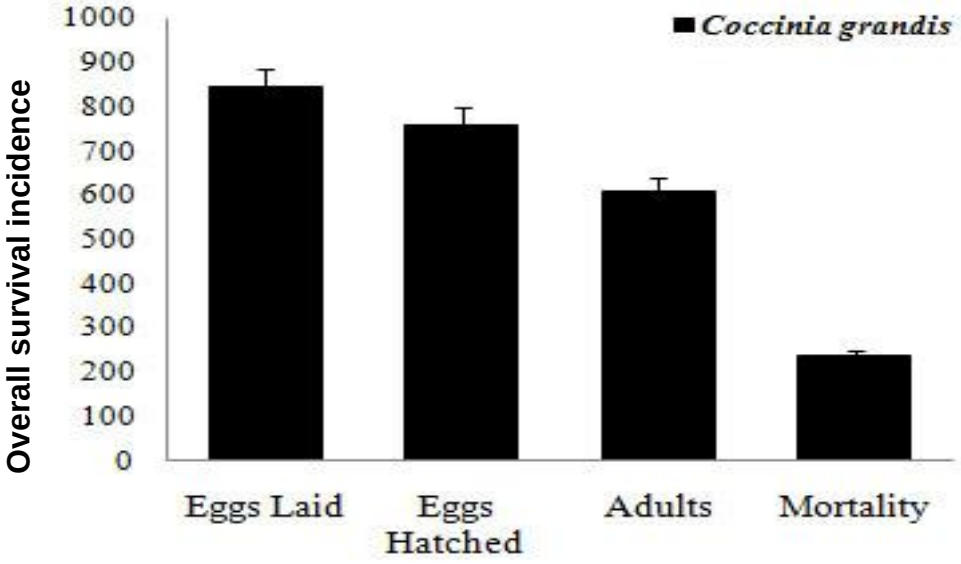

Figure 4. Graph showing relation overall survival rate and adults emerged in *E. vigintioctopunctata* when fed on leaf of *C. grandis*.

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REFERENCES

Austin GO (1925). Some beetle pests of cucurbits in Ceylon. Rev. Appl. Entomol. Series A, 13(7): 358.

Bind RB (1998). Bioecology and behaviour of a ladybird beetle *Cheilomenes* (¼ *Menochilus*) *sexmaculata* (Fabricius) (Coleoptera: Coccinellidae). PhD thesis, University of Lucknow, Lucknow.

Courtney SP, Chen GK, Gardner A (1989). A general model for individual host selection. Oikos. 55: 55-65.

Dash AK, Mishra CSK, Nayak BK, Dash MC (1993). Effect of mating duration on oviposition rate and hatchability of the Indian Tasar Silk moth Antheraea mylitta (Saturnnidae) in different seasons. J. Res. Lepid, 32: 75-78.

Froggatt W (1923). Insect pests of cultivated cotton plant. No. 4. Cutworms and leaf-eating beetles. Agri. Gaz. N.S.W., 34: 343-348.

Imura O, Ninomiya S (1978). Quantitative measurement of leaf area consumption by *Epilachna vigintioctopunctata* (Fabricius) (Coleoptera: Coccinellidae) using image processing. Appl. Ent. Zool., 33(4): 491-495.

Jolly MS, Sen SK, Ahsan MM (1974). Tasar culture (1st Ed.). Central Silk Board, Bombay, India, pp.1-266.

Jones CG, Hoggard MP, Blum MS (1981). Pattern and process in insect feeding behavior: a quantitative analysis of the Mexican bean beetle, *Epilachna varivestis*. Ent. Expt. Appl., 30(3): 254-264.

Kalshoven LGE (1981). Pests of crops in Indonesia (P.A. van Der Laan, rev. and transl.). P.T. Ichtiar Baru-Van Hoeve, Jakarta.

Katakura H, Abbas I, Nakamura K, Sasaji H (1988). Records of epilachnine crop pests (Coleoptera: Coccinellidae) in Sumatera Barat, Sumatra, Indonesia. Kentyu, 56: 281-297.

Khan MH, Islam BN, Rahman AKMM, Rahman ML (2000). Life table and the rate of food consumption of epilaclina beetle, *Epilachna dodecastigma* (Wied) on different host plant species in laboratory condition. Bangladesh J. Ent., 10(1-2): 63-70.

MINITAB-13.1(2003) Minitab Inc., State College, PA, USA.

Nakamura K (1976a). Studies on the population dynamics of the 28-spotted lady beetle, *Henosepilachna vigintioctopunctata* F. I. Analysis of life table and mortality process in the field population. Jap. J. Ecol., 26: 49-59.

Oliff AS (1980). The leaf-eating ladybird (*Epilachna vigintioctopunctata* Fabr.). Agri. Gaz. N.S.W., 1: 281-283.

Omkar, Rastogi S, Pandey P (2009). Effect of temperature on reproductive attributes of the Mexican beetle, *Zygogramma bicolorata* (Coleoptera: Coccinellidae). Int. J. Trop. Ins. Sci., 29(1): 48-52.

Pervez A, Omkar (2004). Temperature dependent life attributes of an aphidophagous ladybird beetle, *Propylea dissecta* (Mulsant). Biocont. Sci., Tech. 14: 665–673.

Prodhan S, Jotwani MG, Prakash S (1990). Comparative toxicity of insecticides to the grub and adult of *Epilachna vigintioctopunctata* Fab. (Coleoptera: Coccinellidae). Ind. J. Ent., 24(4): 223.

Rahman MM (2002). Studies on the biology, feeding behavior and food preferences of *Epilachna dodecastigma* (Wied) on different host plants. M.S. Thesis. Department of Entomology. Bangladesh Agricultural University, Mymensingh.

Rajgopal D, Trivedi TP (1989). Status biology and management of epilachna beetle, *Epilachna vigintioctopunctata* Fab. (Coleoptera: Coccinellidae) on potato in India. Trop. Pest. Manag., 35(4): 410-413.

Richards AM (1983). The *Epilachna vigintioctopunctata* complex (Coloeptera: Coccinellidae). Intern. J. Entomol., 25: 11-41.

Singer MC (1982). Quantification of host preference by manipulation of oviposition behavior in the butterfly, *Euphydryas editha.* Oecol., 52: 224-229.

Thompson JN, Pellmyr O (1991). Evolution of oviposition behavior and host preference in Lepidoptera. Annu. Rev. Entomol., 36: 65-89.

Thompson JN (1988a). Variation in preference and specificity in monophagous and oligophagous swallowtail butterflies. Evol., 42: 118-128.

Thompson JN (1988b). Evolutionary genetics of oviposition preference in swallowtail butterflies. Evolutionary, 42: 1223-1234.

Tilavov TT (1981). The daily and seasonal feeding rhythm of the adult of the cucumber beetle, *Epilachna chrysomelina* Fab. Uzbek. Biol. Zhur, 8(5): 40-61.

Wiklund C (1981). Generalist vs. specialist oviposition behaviour in *Papilio machaon* (Lepidoptera) and functional aspects on the hierarchy of oviposition preferences. Oikos, 36: 163-170.

Wiklund C (1982). Generalist versus specialist utilization of host plants among butterflies. In *Proceedings of the 5th International Symposium on Insect-Plant Relationships,* Wageningen: Cent. Agric. Pub. Doc., pp. 181-191.