ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 6, Issue, 07, pp.7386-7388, July, 2014

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

DEVELOPMENT OF MYCOPHAGOUS LADYBIRD BEETLE, *PSYLLOBORA BISOCTONOTATA* (MULSANT) (COLEOPTERA: COCCINELLIDAE) ON POWDERY MILDEW (*ERYSIPHE POLYGONI* DC) OF BLACKGRAM (*VIGNA MUNGO* L. HEPPER)

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ARTICLE INFO

Article History:
Received 16th April, 2014
Received in revised form
24th May, 2014
Accepted 08th June, 2014
Published online 20th July, 2014

Key words:
Psyllobora bisoctonotata,
mycophagous,
powdery mildew and blackgram.

ABSTRACT

In India a number of agriculturally important crops are attacked by the obligate biotrophic fungi of the family Erysiphaceae (Ascomycota: Erysiphales) causing powdery mildew resulting in great economic losses. *Psyllobora bisoctonotata* (Mulsant) a mycophagous coccinellid (Coleoptera: Coccinellidae) has been found to feed on powdery mildew in natural condition. A study was conducted to gather information on the development of *P. bisoctonotata* feeding on the powdery mildew (*Erysiphe Polygoni*) of the blackgram (*Vigna mungo*). Results indicate short developmental duration and higher survival ratio.

INTRODUCTION

Powdery mildew is a fungal disease affecting a wide range of plants is caused by many different species of fungi belonging to the order Erysiphales. The disease can be easily differentiated from other diseases due to distinctive symptoms as the infected plants display white powdery spots on the leaves and stems. The lower leaves are the mostly affected but the any above ground part of the plant may also show symptoms of the disease. With the progression of disease the spots get larger and denser as large numbers of asexual spores are formed infecting the whole plant. Powdery mildew grows well in environments having high humidity and moderate temperatures (Huang *et al*., 2000). The obligate biotrophic fungi of the family Erysiphaceae (Ascomycota: Erysiphales) are one of the most destructive pathogens infecting thousands of plant species worldwide. Economic yield losses due to powdery mildew infection have been reported in various crops within several families including, Asteraceae, Malvaceae, Cucurbitaceae, Verbenaceae, Solanaceae and Leguminosae, besides many cereals and fruit trees (English-Loeb *et al*., 2007 and Khodaparast and Abbasi, 2009). Application of synthetic fungicides is the only means of control practiced, though studies in this field have proved that most of the powdery mildew diseases on important crops had already acquired resistance to the majority of these chemicals (McGrath, 2001). Numerous mycophagous insects and mites, and mycotoxicant fungi have been found promising to combat powdery mildews as biocontrol agents (Sutherland and Parrella, 2006, English-Loeb *et al*., 2007, Sutherland and Parrella, 2009a, Sutherland and Parrella, 2009b; Raja, 2010). Mycophagous ladybird beetles placed in the tribe Psylloborini (Coleoptera: Coccinellidae) are obligate feeders of all life stages (conidia, conidiophores, hyphae, cleistothecia, etc.) of Erysiphales powdery mildews.

The cosmopolitan distribution of *Psyllobora* species, particularly in temperate and subtropical regions including several Arabian and African countries, besides their wide host range on different plants (Khan *et al*., 2007, Joshi and Sharma, 2008, Ahmad *et al*., 2003, Ahmad *et al*., 2009 and Sutherland and Parrella, 2009b) suggests their importance in ecological balance and natural control of the powdery mildews. Since the relationships of fungi and beetles are very diverse sometimes acquiring quite complicated form (Cruz *et al*., 1989; Almeida and Milleo, 1998) a study was conducted to gather information on the life cycle of *Psyllobora bisoctonotata (*Mulsant) feeding on the powdery mildew (*Erysiphe Polygoni* DC) infesting the blackgram plants (*Vigna Mungo* L. Hepper).

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MATERIALS AND METHODS

P. bisoctonotata was studied for getting information on the life cycle in the Physiology and Biochemistry Laboratory of Department of Biological Sciences, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Naini, Allahabad in the year 2013-2014. The beetles including both adults and grubs were found feeding on the powdery mildew (*Erysiphe polygoni* DC) infesting the leaves of blackgram (*Vigna Mungo* L. Hepper). The population reaches its peak in the months of December and January as the disease also attains the epidemic proportion by infecting almost every leaf and all exposed portions. The ladybird beetles were brought to the laboratory and mating pairs were separated. The mating pairs were then reared under laboratory conditions in the plastic Petri dishes 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 which were reared till adult emergence and the adults were used for the experiment. The prime objective was to study the development of grubs of *P. bisoctonotata* on powdery mildew of blackgram. Eggs collected from different females were taken and placed in Petri dishes (4 eggs per Petri dish) and allowed to hatch. Grubs hatched from the eggs were fed on *ad libitum* supply of powdery mildew. The leaves were changed after every 24 hours in order to avoid microbial contamination and a moistened piece of cotton plug was also kept in the Petri dishes in order to avoid drying of food. The data on developmental duration, survival and mortality was recorded daily. The data obtained on development was analyzed by one way ANOVA by taking 'Food' and 'Larval Stage' into consideration. The data on survival and mortality was analyzed by Chi-square test (Minitab, 2000). Ten replications were used.

RESULTS AND DICUSSION

One way ANOVA showed a significant interaction between 'Developmental duration' and 'Grubs' (First instar (L1): $F=7.13$; $P<0.05$; Second instar (L2): $F=1.85$; $P<0.05$; Third instar (L3): $F=11.87$; $P<0.05$; Fouth instar (L4): $F=9.18$; $P<0.05$; Prepupa: $F=6.09$; $P<0.05$; Pupa: $F=16.63$; $P<0.05$) (Fig.1). Higher survival and lesser mortality as depicted by Chi Square test ($\chi 2=12.10$; $P<0.05$) was found (Fig. 2).

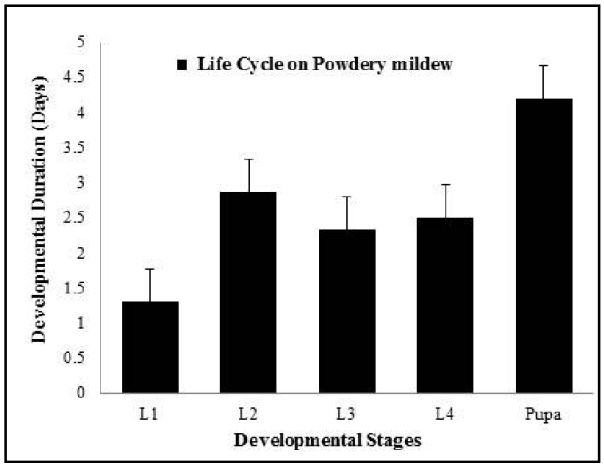

Figure 1. Developmental duration of different life stages of *P. bisoctonotata* on the powdery mildew (*E. Polygoni*) of the blackgram (*V. mungo*)

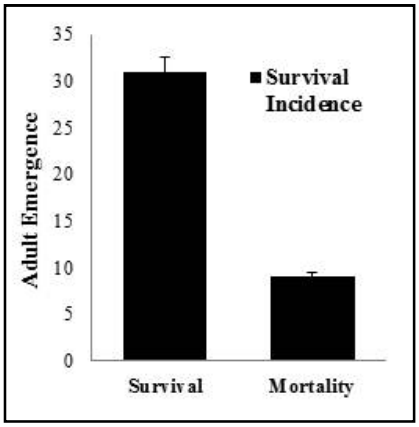

Figure 2. Overall survival and mortality of *P. bisoctonotata* on the powdery mildew (*E. Polygoni*) of the blackgram (*V. mungo*)

Our results indicate that the grubs feed perfectly on the powdery mildew (*E. polygoni*) of the blackgram plants (*V. mungo*) as the developmental duration was short and higher survival ratio was obtained. It was also observed that the feeding efficiency of the first instars was low due to their small body size and soft mouth parts but the feeding efficiency increased as the grubs underwent moulting. Second instar grubs had moderate feeding efficiency which further increased in case of the third instars. However, fourth instars showed less feeding efficiency as compared to the third instars so it can be concluded that the third instar grubs were the voracious feeders. On the basis of their feeding efficiency the grubs can be ranked as follows: third instar, fourth instar, second instar and first instar. The grubs were found to undergo pupation on the lower surface of the leaves from which later on the adults were emerged. The larvae were found to aggregate on the lower surface of the infested leaves. Higher survival incidence and short developmental duration indicates that the powdery mildew (*E. polygoni*) is replenished with all the essential nutrients required for survival of the grubs aiding in better and healthy development of the grubs. On the basis of their feeding behaviour and potential the *Psyllobora bisoctonotata* is now being universally exploited for the biological control of this destructive fungus (Cruz *et al*., 1989; Almeida & Milleo, 1998).

Acknowledgement

The author is grateful to the Head, Department of Biological Sciences, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Naini, Allahabad, India for constant encouragement and providing essential laboratory facilities.

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