PREDATORY EFFICIENCY OF *CHEILOMENES SEXMACULATA* (FABRICIUS) (COLEOPTERA: COCCINELLIDAE) AGAINST *APHIS CRACCIVORA* KOCH ON VARIOUS HOST PLANTS OF FAMILY FABACEAE

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Abstract

Coccinellid beetles due to high foraging performance, immense predatory potential and high reproductive efficacy, they possess the potential to be effectively employed in biological control programmme for controling several destructive insect such as white flies, coccids, thrips, mites, adelgids, psyllids, mealy bugs and scale insects. *Cheilomenes sexmaculata* is predominent species against *Aphis craccivora* in different localities of Bihar on agricultural and horticultural plants (Ahmad et al., 2012). The knowledge of predatory efficiency plays an important role in mass rearing and its utilization in management programme. The effect of host plants quality on the development and feeding potential of each instars and adult stages of *C. sexmaculata* was investigated. The greater consumption of *A. craccivora* was observed by both adult and grubs on *P. sinensis* (717. 0±10.33 aphids) followed by *L. purpureus* (655.8±18.19 aphids), *V. radiata* (620.8 ± 5.04 aphids) and *V. mungo* (546.2±12.39 aphids). The larval and adult stages of *C. sexmaculata* consumed more *A. craccivora* on *P. sinensis* than other host plants. Many intrinsic characteristics of plants such as nutritional value, secondary chemicals, and morphology can influence the feeding potential of predators. Thus, in the present investigation more feeding potential was observed on *P. sinensis* is due to high nutritional values of the host plants.

Keywords: Aphis craccivora, Cheilomenes sexmaculata, feeding potential, tritrophic effect

Introduction

The efficacy of a predator is one of the essential factors to be investigated before implementation of any biological control programme (Jafari and Goldasteh, 2009). Food specificity has been a long standing and important issue in the ecology of ladybirds. Many ladybirds are not generalists but have specific food requirements. The role of host plants in the tritrophic interactions involving the predator, prey and host plant need to drive step of evaluated the efficacy of biological control agent. Complexity of tritropic interaction arises as the host plant may influence the nutritional quality of aphid prey for predators that consume them (Blackman 1967, Francis et al., 2001 a, Giles et al.,2002, Wu et al.,2010).

Allelochemical compounds of host plant are the one of explanation of unsuitability prey to predatory lady beetle. Some evidence that concentration of glucosinolates (GLS) in host plant influenced to lady beetle development. In other cases, some allelochemicals such as linamarin acted as defensive compounds to reduce ability of herbivore to utilize plant protein. As a result, prey quality is reduced and development of predator also decreased. (Francis et al., 2001 b; Pratt et al., 2008; Riddick et al., 2011).

The nutritional value, secondary chemistry and morphology of plants can influence the fecundity, growth, and survival rate of pests (Hodek 1957; Okamoto 1966; Campbell et al., 1980) and quality of prey influence the predatory potential of predators (Francis et al., 2000; Obrycki & Orr, 1990; Mari et al., 2005; Omkar & Mishra, 2005; Omkar et al., 2009; Jindal & Malik, 2006; Devi et al., 2008; Sharmila et al., 2010; Inayat et al., 2011; Nayaanga et al., 2012; Shah & Khan, 2014).

In spite of promising results, aphidophagous coccinellids, a simplification of rearing techniques is necessary to make ladybird production cheaper and to promote their use in biological control, specially for inundative release. However, further study should be focused on host preference of lady beetle for deeper understanding of host utilization by lady beetle in cropping systems. Hence, the predatory efficiency of *Chielomenes sexmaculata* on various leguminous plants was evaluated to know the suitable host for mass culture of this predator.

Materials & Methods

A culture of large number of larvae and adult predator of *C. sexmaculata* was established in the laboratory in order to supply aphids reared on different host plants viz., *Phaseolus sinensis*, *Lablab purpureus*, *Vigna mungo* and *Vigna radiata* for the experiment. *A. craccivora* were also collected daily with infested leaves of each host plants from experimental field and supplied as food. Mating pairs were collected from the stock culture and beetles were reared on aphids on its host plants in separate beaker (25cmx10cm) at room temperature (19.45±0.55°C and 60.85±1.015% R.H). The blotting paper was placed in the bottom of beaker and top covered by muslin cloth. The eggs laid by these pairs on different host plants were used in experiments. Fresh eggs were collected from stock culture from each host plants. After eggs hatching, the 10 sets of each group of neonate larvae were reared on aphids with host plants viz., *L. purpureus*, *P. sinensis*, *V. mungo* and *V. radiata* in glass containers to avoid cannibalism. 100 aphids/predator of mix age were provided daily to each larva till the emergence of adults. The post–embryonic developmental period and adult longevity were recorded. For evaluating the predatory potential of each instars stage as well as in adult, unconsumed and dead aphids were counted daily. The fresh aphids were provided daily till the death of predators.

Results & Discussion:

The feeding potential of each larval stage was observed very high when *A. craccivora* reared on *P. sinensis* than other host plants (Table-1). The variation between instar stages and host plants is observed highly significant by ANOVA test ($F1=11.58473$; $F2=209.8094$ $P<0.05$). Similarly, grubs of *C. sexmaculata* devoured more aphids when reared *on P. sinensis* (158.8±1.59 aphids) and *L. purpureus* (141.4±6.67 aphids) than other host plants during developmental period (Table-1). However, Lokeshwari et al., (2010) reported that, this predator consumed more *A. craccivora* (292.40±3.68 aphids) reared on *L. purpureus* during its total larval development at 25±2ºC. This difference is probably due to high temperature. It was also observed that the, adult *C. sexmaculata* (plate-2) consumed more aphids when reared on *P. sinensis* (558.2±10.45 aphids) followed by *L. purpureus* (514.4±15.47 aphids); *V. radiata* (489.4±4.27 aphids) and *V. mungo* (421.20±1.34 aphids) (Table-1). Similar observation was also made by Rattanapun, (2012).

Table- 1: Predatory efficiency of Larvae and adult C. sexmaculata on A. craccivora among various host plants (means±SE).

Host plants	*P. sinensis*	*L. purpureus*	*V. radiata*	*V. mungo*
Ist instar	22.4±1.03	19.2±1.68	13.8±1.32	9.2±0.37
IInd instar	33.4±0.92	31.6±1.33	30.8±2.34	29.8±1.88
IIIrd instar	45.2±1.96	39.2±3.04	39.8±0.49	36.8±2.46
IVth instar	57.8±1.16	51.4±1.94	50.2±3.92	49.2±1.71
Total Larval consumption	158.8±1.59	141.4±6.67	134.6±3.92	125.0±2.85
Consumption by female	584.66±1.52	531.00±1.52	519.66±2.60	443.00±0.88
Consumption by male	532.06±0.57	498.00±2.08	464.33±1.73	407.66±1.00
Average of Adult consumption (male+female)	558.2±10.45	514.4±15.47	489.4±4.27	421.20±1.34
Larval & Adult consumption	717.0±10.33	655.8±3.64	620.8±5.04	546.2±12.39

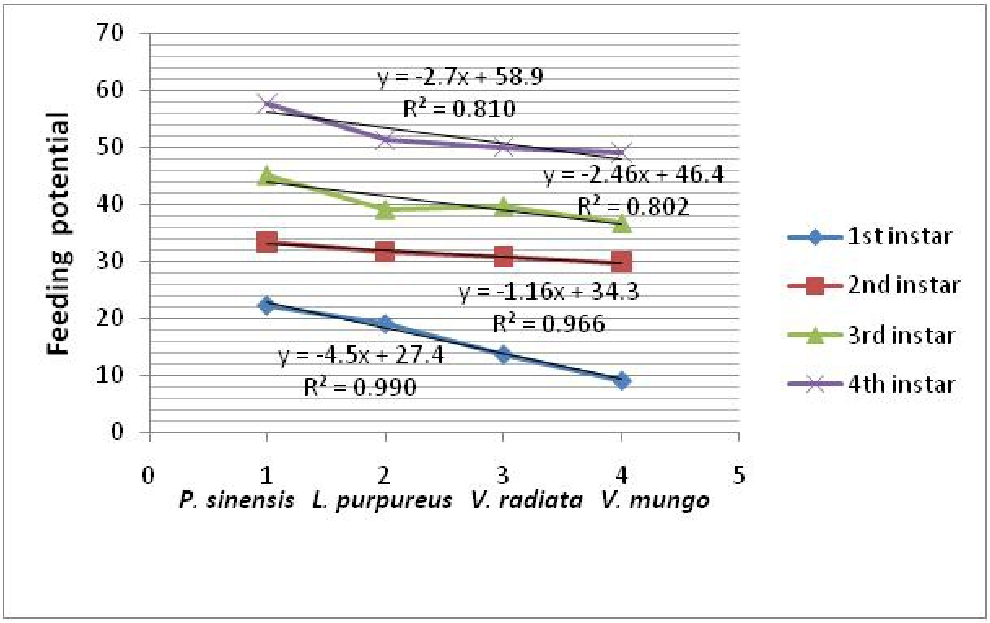

Fig 1: Relationship between feeding potential of grubs and host plants

Plate-1: 4th instar consuming *A. craccivora.* **Plate-2: *C. sexmaculata* against *A. craccivora.***

The feeding potential of *C. sexmaculata* increased with the increase of age of grubs due to more requirements of nutrition on each plants. The positive linear correlation is observed between feeding potential of each larval stages of predator and host plants (Fig.-1). The 4th instar grub (Plate-1) consumed significantly more aphids per day than the other instar grubs and adults (Table-1). Ali & Rizwi (2009) has also reported that the 4th instar grubs of *C. sexmaculata* consumed more *L. erysimi* significantly when compared to 1st, 2nd and 3rd instars per day. Similar, observation has been also made by several workers (Mari et al., 2005; Solangi et al., 2007;

Rattanapun, 2012). This predator consumed more *A. craccivora* on host plant *P. sinensis* than *L. purpureus*, *V. mungo* and *V. radiata* during its life span and also during larval development period.

The feeding potential of female was always observed high on all host plants as compare to male (Table-1). However, this difference is observed not significant by statistical analysis (t-value =1.1, $P<0.05$). Similarly, Pandi et al., (2012) reported that female *C. sexmaculata* consumed more *A. craccivora* in compare to male. It is because of female survives more days in compare to male. According to Mrosso et al., (2013) females take shorter time in chasing, catching, subduing and injesting the prey therefore, they are able to consume more prey within shorter time in compare to male beetles. Chemical constituents of host plants are one the explanation of unsuitability or suitability prey to predatory lady beetle (Omkar & Mishra, 2005; Chowdhury et al., 2008).

Morphological structure of leaves also effect the predatory potential of *C. sexmaculata*. Plants physical properties like presence of trichome on the leaves of *V. mungo* and *V. radiata* affect the searching efficiency of predators and during observation found low efficiency on these host plants. Dalin et al., (2008) also reported the negative effect on both predators and parasitoids in movement and searching time. A perusal of literature revealed that, the abundance and effectiveness of natural enemies were found to be negatively correlated with the density of the plant trichomes (Romeis et al., 1998, 1999; Krips et al., 1999, Rosenheim et al., 1999; Lovinger et al., 2000; Fordyce & Agarwal, 2001; Stavrinides & Skirvin, 2003; Olson & Andow, 2006; Dalin, 2008).

Thus, it can be concluded that *P. sinensis* and *L. purpureus* are mort suitable host plants for mass culture of this predator and due to high predatory potential they might be considered promising candidates for biological control.

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