Artificial rearing on the nymphal developmental time and survival of three reduviid predators of Western Ghats, Tamil Nadu

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ABSTRACT

The possibility of more numbers of entomophagous insects for their use in biological control strategies is an old objective carried on, among others, by the rearing in different kinds of artificial diets. The artificial rearing of predatory insects started a long time ago, with the main goal of obtaining a mean to multiply and produce predators to be released in biological control strategies. Reduviid species are biological control agents of numerous invasive pests. However, very few insects have been used in the pest management programme because of the lack of rearing methods. For the first time rearing of three reduviid predators like *Sycanus collaris, Panthose bmaculatus* and *Panthose bmaculatus* using meat-based artificial diet under laboratory conditions has been introduced. Incubation period is shorter in *Rhynocoris kumarii* Ambrose and Livingstone (10 days) than *Sycanus collaris* (15 days) and *Panthose bmaculatus* (21 days). *Panthose bmaculatus* significantly took more days to complete the nymphal developmental period (101.12 ± 2.30 days) with more survival rate (62.94) than other reduviids. The result suggests that these reduviids can be reared using meat-based artificial diets and can be utilized in pest management programme.

Key words: Artificial rearing, reduviids, nymphal development, survival

INTRODUCTION

Evaluation of entomophages in augmentative biological control programmes is hampered by the difficulty in producing large numbers of zoophagous eating arthropods. An important difficulty is the production of a large number of prey insects to serve as food for the entornophages. Therefore, the development of a nutritionally adequate artificial diet for entomophagous insects is an important accomplishment in the progress of biological control prgrammes.

Assassin bugs are serious predators of other insects especially economically important pests of agriculture and forest. The strategy for utilization of reduviids for biological control of many species of economic insect pests in India has been intensively investigated by the researcher since 1987. Our research revealed that artificial rearing is very imperative for the rearing or mass production of reduviids which could be used in pest management. *Sycanus collaris* (Fabricius) is mainly distributed in South east Asia particularly in India

(Ambrose, 2006), Thailand (http://www.searca. org), Taiwan (Shiuh-Feng Shiao. 2006), Bengal; Ceylon (Green), Malacca ect.. It is reported as an natural enemy of *Helicoverpa armigera* Hubner (www.niaes.affrc.go.jp/sinfo/sympo/h22/1109/ paper_12.pdf; Nath *et al.,* 1981), *Mestocharella indica* Jaikishan Singh and Khan (http://www.nhm.ac.uk/researchcuration/research/ projects/chalcidoids/database/named Host. dsml? HOSGENUS=Sycanus&HOSSPECIES=collaris& &); teak defoliator, *Hyblaea puera* Cramer (Hutacharern and Choldumrongkul, 1995); uzi fly, *Blepharipa zebina* Walker (Ram *et al*., 2009); Craspedonata leayana (http://chm-thai.onep.go.th/ chm/Doc/Publication/ONEP01/05_Forest_Insects-Table4.pdf); tortoise beetle and caterpillar of success (http://khaophrathaew.org/ Biodiversity_ Fauna_Oth6.html).

The biology, life tables and intrinsic rate of natural increase of a harpactorine reduviid *Rhynocoris kumarii* against three lepidopteran insect pests, *Spodoptera litura, Earias*

vittella and *Corcyra cephalonica* have been constructed under laboratory conditions (George, 2000). Another predator, *Panthous bimaculatus* Distant has been distributed in Indian forests and reported here for the first time as a predator of *Atteva fabriciella* and *Eligma narcissus* occurred in good numbers (Varma, 1989; Varma, 1991; Nair, 2007). No other information on this predator is available in literature. No definite methodology or prey has been recommended for these reduviids. Thus there is a need to find the best artificial method for raring these reduviids using artificial diet. Overall, this study had to evaluate the effect of meat-based artificial diet on the nymphal developmental time, survival and adult sex ratio of *R.kumarii, P. bimaculatus* and *S. collaris* reared on artificial diet. Results are discussed considering the use of this predator as a biological agent against economically important agricultural and forest pests and the potential development of augmentative releases.

MATERIALS AND METHODS

Insects used in the study were obtained from southern Western Ghats of Tamil Nadu, India during 2009-2010. Initially all predators (adults and nymphs) were maintained under laboratory conditions (28-30^{o}C temperature, 70-75% relative humidity and 11-13 hrs day and night) with a third to fifth stadium larvae of *Corcyra cephalonica*. Water was provided with a wet piece of sponge. Predator eggs were collected on folded paper towels. The incubation period of predators was determined by placing more than 100 newly laid eggs individually on a piece of Whatman filter paper in a Petri dish (9 cm diameter and 1 cm height), so that after egg hatching only 50 to 60 newly hatched nymphs were used for further observation. The incubation period of each egg was recorded until 80-90 newly hatched nymphs were obtained. Nymphs were fed a meat-based diet-that is a mixture of foodstuffs and other ingredients that has been used to rear reduviids (Sahayaraj *et al*., 2006, 2007). To avoid cannibalism, newly hatched nymphs were kept individually in 100 mL capacity plastic boxes covered with ventilated lid. Each nymph was provided with artificial diet soaked cotton and a moistened sponge every 2–3 days. When nymph attained in to third stadium, they were transferred into another plastic container (180 mL capacity). This allowed collection of unfed diet containing cotton swabs and moulted skins (checked every 2 days). Observations continued until each nymph either died or matured. Stage-specific mortality was recorded. The duration of each stadium was recorded as the number of surviving individuals in that particular stage. This was used to calculate the mean duration of successive nymphal instars. After the emergence, sex ratio was calculated (number of females emerged/total number of predators emerged). Nymphal periods were subjected to ANOVA using SPSS (version 11.5). The significance was expressed in 5% level.

RESULTS AND DISCUSSION

Incubation period is shortest in *R. kumarii* (10 days) than *S. collaris* (15 days) and *P. bmaculatus* (21 days). Sundarraju (1984) reported that *S. collaris* incubation period was 11 days and the total nymphal developmental time was 77 days indicated that artificial diet slightly reduced the total nymphal developmental time. Thus the proposed diet can be utilized for the mass production of this reduviid. The total nymphal developmental time was shorter in *S. collaris* ($P<0.05$) than in the other two reduviids. In general first instar was shorter whereas fifth instar was the longest stadium in all the tested reduviids (Table 1). The total nymphal duration of *R. kumarri* was 49.3±1.95 days (George *et al.*, 1998). It was extended more than 1.7 times while it was reared with artificial diet. This indicates that artificial diet composition could be modified for the shortening of the nymphal developmental time of the reduviids. However, the total nymphal developmental period of *R. kumarri* varied between 63 to 98 days depending on the type of prey offered (Sahayaraj, 2007). Hence, the proposed diet can also be used for the rearing of *R. kumarri* too. The total nymphal survival rate was higher for *R. kumarii* (62.94) than for *S. collaris* (46.16) and *P. bimaculatus* (16.23) (Figure 1). In the present study, artificial diet on the reduviid predators *R.umarii, Panthous bimaculatus* and *Sycanus collaris* were examined under laboratory conditions. Artificial diet has previously been reported for reduviids by

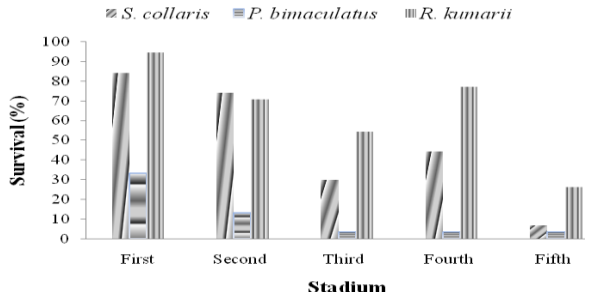
Table 1. Nymphal developmental time (days), sex ratio of three reduviid predators reared with artificial diet which collected from southern Western Ghats of Tamil Nadu

Predator life stage	*Sycanus collaris*	*Rhynocoris kumarii*	*Panthose bmaculatus*
I	11.07±0.89	11.44±0.10	15.76±1.36
II	17.81±0.95	12.88±0.72	17.00±3.27
III	22.75±4.17	17.50±2.15	19.25±5.08
IV	15.57±3.83	19.23±2.49	21.00±1.30
V	23.33±8.21[a]	31.20±4.80[b]	27.03±0.99[c]
I- Adult	75.67±9.06[a]	88.30±3.60[b]	101.12±2.30[c]
Sex ratio	1 : 0.67	1:0.50	1: 0.60

Same alphabets in a row shows the significance at 5% level

Sahayaraj *et al.* (2006; 2007); Sujatha and Sahayaraj (2007) and Sahayaraj and Balasubramanian (2008). The approaching behavior of *R. kumarii, P. bimaculatus* and *S. collaris* life stages with the antennae forward, suggests a visual and chemical recognition of the diet as observed for *Rhynocoris marginatus* (Fab.) (Sahayaraj *et al.*, 2006; 2007; Sujatha and Sahayaraj, 2007) during feeding.

Figure 1. Survival rate (%) of the three reduviid predators reared with artificial diet



All of the diets had nutritional qualities that allowed complete development of the predators to a greater or a lesser extent, indicating that there is a potential for rearing this insect on artificial media and that the OD diet used here was adequate, allowing the nymph to acquire food and develop into the adult stage (De Clercq *et al*., 1998). Invariably the sex ratio was female biased for all reduviids. Long and Zaher (1958) reported that insect reared on different diets produced maximum adults with greater effects on female. Field survey also revealed that invariably the population of female was higher than that of males.

Our study demonstrates that reduviid predator feeding behavior cannot be modified if they are provided with artificial diet as food. Differences in the nymphal development and survival demonstrate that these predators can adapt their feeding behavior according to the food provided. Since the proposed diet could not change the total nymphal developmental period of *R. kumarii and S. collaris*, artificial rearing can be carried out on the proposed diet.

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